Performing Work on Hydro's Overhead Distribution Network Version 1.1

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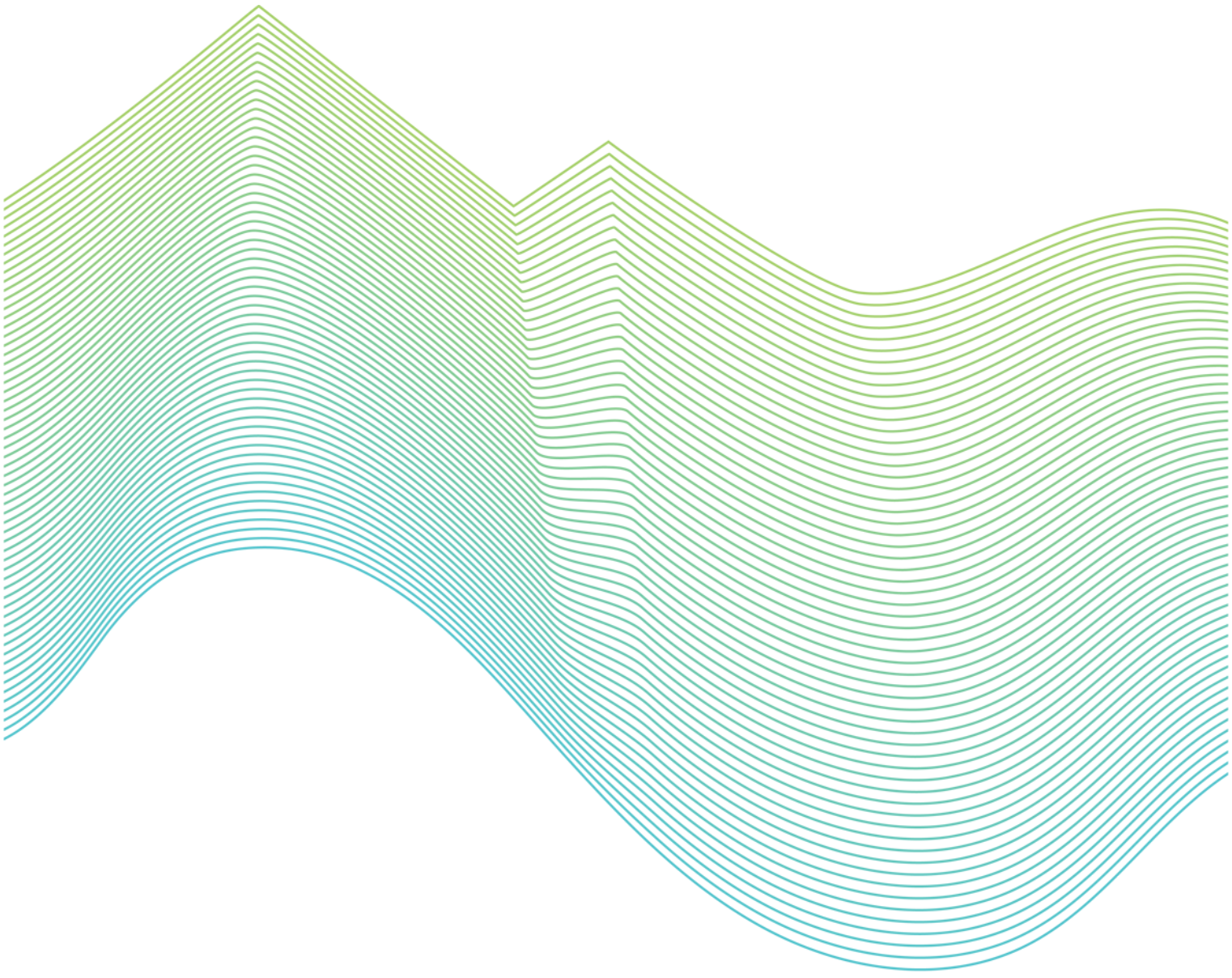

Contents

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1	July 2019	New document	Manager TVPS, BSI and WHS
1.1	October 2023	Minor revision	Operational Competency Manager

1.0 INTRODUCTION

1.1 Purpose

The purpose of this handbook is to specify safe working requirements, work practices, technical information, minimum standards and compliance requirements for carrying out line work activities associated with the Hydro Tasmania Overhead Distribution Network. This standard needs to be used in conjunction with the Hydro Groups safety management system and where specified, TasNetworks system documents. Where there is a conflict between the SWP Handbook, other system documents – this standard must be followed.

This handbook contains:

- A summary of key work requirements for key tasks; and
- A consolidated source of key operational information from various sources.

The Handbook is a controlled document and must be regularly reviewed to ensure its contents are current.

In addition to being used for field work this handbook will be used as a training reference document to assist all practitioners and other relevant persons who have a vested interest in Distribution System line work and maintenance of these assets within Hydro Tasmania.

1.2 Scope and Application

1.2.1 Scope

The information in this document applies to all persons working for or on behalf of Hydro Tasmania - associated with work on or in close proximity to Hydro's overhead Tasmania distribution system assets. Covering High Voltage lines up to and including 22,000 volts from Substations to Low Voltage supply on the line side of customer main switches.

1.2.2 Roles and Responsibilities

Hydro Tasmania and Service Provider employees at all levels (includes Production Managers, Project Managers, Team Leaders etc. in charge of field employees) must ensure they comply with the requirements contained in this Handbook to ensure distribution line work is carried out in a safe and professional manner.

Employees – To follow the Documentation within the Distribution Linesperson Handbook and suggest to their Team Leaders opportunities for improvement.

Team Leaders – To ensure the Handbook contains the most up-to-date information and is readily available to employees. They are to also escalate opportunities for improvement to their relevant Manager.

2.0 REFERENCES

This Handbook makes reference to the following key relevant documents:

- TasNetworks Distribution Overhead Line Design & Construction Standard
- ENA National Guidelines
- TasNetworks Service and Installation Rules

2.1 Definitions

Permit to Work

Means any form of authorisation, which allows access to work on or near, or for the testing of, apparatus.

Access, egress and transfer

Vertical or horizontal movement of a person.

Accident

An incident which causes personal injury or loss / damage to Hydro Tasmania Assets.

Aloft

At or above the minimum height specified by jurisdictional requirements at which fall prevention measures are to be applied.

Anchorage

A secure attachment on a structure to which a fall arrest device or lanyard assembly or restraint line may be attached.

Apparatus

Means electrical apparatus and mechanical apparatus.

Approved

Means having appropriate organisation endorsement in writing for a specific function.

Attached

Continuously connected to a structure or platform.

Attached Climbing

Continuously connected to a structure or platform while accessing, egressing from, working upon or transferring between.

Authorised Person

Means a person with technical knowledge or sufficient experience who has been approved, or has the delegated authority to act on behalf of the Organisation, to perform the duty concerned.

Bare

Means, in relation to a conductor, not insulated.

Barrier

Means a rope, tape, barricade or alternative erected in accordance with approved procedures.

Bond

The connection of conductive objects together in such a manner as to ensure that they are at the same electrical potential.

Brush Contact

Inadvertent momentary contact with an insulating barrier covering energised conductors or equipment.

Cable

Means an insulated conductor or two or more such conductors, laid together with or without fillings, reinforcements or protective coverings. Cable for the purpose of this document also means Aerial Bundled Cables (ABC).

Certificate

A document issued by a Registered Authority as confirmation that an individual has been assessed and deemed competent to perform specific tasks.

Certified

A person who has satisfactorily completed training and been assessed as competent to the standards for which a certificate is issued.

Competent

Having the skills, knowledge and attributes a person needs to complete a task safely and to required standards.

Competency

Acquisition through training, qualification or experience or a combination of those things of the knowledge skills and attitudes required to undertake the assigned task competently.

Conductor

Means a wire, cable or form of metal designed for carrying electric current.

Confined Space

Means confined space as defined in Australian Standard, “AS/NZS 2865 Safe Working in a Confined Space”.

An enclosed or partially enclosed space that is at atmospheric pressure during occupancy and is not intended or designated primarily as a place of work, and

Is liable at any time to:

- Have an atmosphere which contains potentially harmful levels of contaminant.
- Have an oxygen deficiency or excess.
- Cause engulfment.
- Could have restricted means for entry and exit.

Control Measures

Means policies, standards, procedures or actions to eliminate, avoid or minimise risks.

Covered

Shielded, surrounded or covered with an approved insulating material such as rubber or PVC insulating mats and hose or PVC covered conductor.

Current Rating

The maximum current permitted to flow (under defined conditions) through items of equipment that form part of a power system.

Current Transformer (CT)

A transformer used with meters and/or protection devices in which the current in the secondary winding is, within prescribed limits, proportional to the current in the primary winding.

Dead

Apparatus which is isolated and at earth potential, but may be subject to induced voltages.

De-Energised

Disconnected from all sources of supply but not necessarily isolated, tested and earthed.

Danger - Do Not Operate Tag

Means an approved tag, used in accordance with approved procedures, warning of a particular hazard or hazardous condition that is likely to be life threatening.

Earthed

Electrically connected to the general mass of earth by means of an approved earthing device to ensure and maintain effective discharge of electrical energy.

Electrical Apparatus

Electrical equipment including overhead lines and underground cables, the conductors of which are alive or can be made alive.

Electrical Connection

A jointing of two or more conductive materials by clamping, bolting, compression, welding or other method for the purpose of allowing electricity to flow through them.

Electrical Operator

A person authorised to carry out operating work on electrical apparatus in accordance with Hydro Tasmania safe work practices.

Electricity Network

Means transmission and distribution systems consisting of electrical apparatus which are used to convey or control the conveyance of electricity between the generator's points of connection and customer's points of connection.

Elevating Work Platform or EWP

Means a vehicle on which a boom type mechanism, either articulating or telescoping, is installed. The mechanism is designed and used for the positioning of personnel at work sites or for positioning both personnel and equipment at work sites.

Emergency

A situation where danger exists to human life, equipment or property.

Employee

An employee of Hydro Tasmania whether under a contract of employment or training and includes a Contractor, and a person employed by a Contractor or Service Provider, who carries out work for Hydro Tasmania.

Employer

Means Hydro Tasmania or Authorised Service Provider, as the case may be who engages a person to perform work.

Energised

Means connected to any source of energy.

Exposed Conductor

Means an electrical conductor, approach to which is not prevented by a barrier of rigid material or by insulation which is adequate under a relevant Australian Standard specification for the voltage concerned.

Fall Arrest System

An assembly of interconnected components comprising a harness connected to an anchorage or anchorage system, either directly or by means of a lanyard or lanyard assembly, for the purpose of arresting a fall.

Fall Arrest Harness

An assembly of interconnected shoulder and leg straps, with or without a body belt, designed for attachment to a lanyard or other type fall arrest device as specified in AS/NZS 1891.3 and used where there is a likelihood of free fall or restrained fall.

Footed

Means physically supporting a portable ladder at the base, to prevent unintentional movement.

Hazard

A source of potential harm or a situation with potential for harm.

High Voltage

Voltages exceeding 1000 volts.

Incident

An unplanned event, which may or may not have resulted in harm to people damage to property or the environment or loss to process.

Insulated

Means separated from adjoining conducting material by a non-conducting substance which provides resistance to the passage of current, or to disruptive discharges through or over the surface of the substance at the operating voltage, to mitigate the danger of shock or injurious leakage of current.

Insulating Barrier (also called cover up equipment)

A barrier of insulating material specifically designed, approved and tested for use as a cover for lines, insulators, cross arms, terminations or similar equipment. Insulating barriers are intended to prevent personnel making accidental brush contact with live components or equipment at a different potential. (Used by Live Line Workers on live high voltage work).

Insulated Elevating Work Platform

An approved and tested insulated telescopic device or articulating device or any combination thereof used to position personnel, equipment and material at work locations, and to provide a working area for persons elevated by and working from the platform.

Insulating Cover

A pipe or tube drape, blanket or wrapping of insulating, non-hygroscopic material applied on or around conducting mains, apparatus, surfaces and pipes so as to prevent inadvertent contact and provide an electrically safe barrier for personnel or equipment working in the vicinity. (Used by Line Workers on live low voltage work).

Insulating Mat

A mat of insulating and non-hygroscopic material intended to effectively provide an electrically safe barrier on which the user can stand, kneel or be otherwise supported. (Used on the ground for live low voltage work)

Isolated

Disconnected from all sources of supply by breaks of a length (distance appropriate to the voltage and insulating medium and rendered incapable of being made alive without premeditated and deliberate manual operation).

Authorised Issuing Officer

A person authorised by the Operating Authority to issue a Permit to Work.

Lanyard Assembly

An assembly of a lanyard and a personal energy absorber.

Limits of Approach

(Minimum Approach Distance below). Line Work.

Is work carried out on any part of a power line, including underground cables, that is part of a power system network.

Line Worker

A person who holds an Electrical Practitioner – Line Worker electrical licence in Tasmania and is trained and authorised to perform line work.

Live (or alive)

Connected to a source of electrical supply.

Live Line Stick (also called Hot Stick)

A length of insulating material specifically designed approved and tested for use to physically bridge the distance between the energised apparatus and earth or between adjacent phases; and to enable physical loads to be taken or tools to be applied to the stick.

Live Line Work

Work performed on apparatus capable of being energised without implementing the full protective practice of isolating, proving de-energised and earthing at the work-site. Work must be scheduled or planned to be completed isolated or de-energised.

Low Voltage

A voltage not exceeding 1000 volts ac. or 1500 volts dc. Defined in AS/NZ 3000.

Manual Re-close

Means an action taken, under the direction of or by the Power Station, involving manually re-energising an electrical circuit in an attempt to restore supply or locate a faulty system.

Minimum Approach Distance

The minimum air gap that shall be maintained between a worker and any other component at different potential during line work, in order to prevent flashover and provide for worker safety.

Minimum Tool Insulation Distance (also called effective length)

The distance that insulating material (stick or rope) is subjected to contacting energised conductors. This distance shall be measured between the metal end fitting at the conductor end of the insulating material and the metal end fitting or hand mark, where provided at the opposite end of the insulating material.

When Live Line sticks consist of sections joined with metal couplings, the insulation distance shall be the total of each of the lengths of insulating material which have not been bridged out by the metal couplings.

Mobile Plant

Any mobile equipment capable of raising or lowering a load. When in travelling mode - it is considered a vehicle and Limits or Minimum Approach distances for vehicles apply.

Must

The word “must” is similar to “shall” and refers to mandatory requirements.

Near

Working at distances up to the specified Minimum Approach or Limits of Approach distances.

Operating Work

The operation of switches, opening and closing of links, removal or replacement of other connections intended for isolation, removal or replacement of fuses, proving that electrical apparatus is de-energised, the earthing and short-circuiting of electrical apparatus.

Operator

See definition for Electrical Operator.

Operating Authority

The Network Service provider responsible for supervision and operation of the power system.

Ordinary Person

Means a person without sufficient training or experience to enable them to avoid the dangers which electrical apparatus may create.

Other Cable Systems

Means telecommunications cables, control cables, aerial earthed cables or electrolysis drainage cables.

Overhead Line

Means any aerial conductor or conductors with associated supports, insulators and other apparatus erected, or in the course of erection, for the purpose of the conveyance of electrical energy.

Person in Charge

The person in charge of a facility or work-site or a person designated to exercise control over a specific work function. An authorised recipient to whom a Permit to Work has been issued and who is in charge of the work-site to which the Permit applies.

Personal Protective Equipment (PPE)

Means clothing, equipment and / or substances, which when worn or correctly used, protect parts or all of the body from foreseeable risk of injury or disease at work or in the workplace.

Portable Ladder

A ladder designed, constructed and used in an inclined standing mode, in accordance with AS / NZS 1892 series.

Qualified

Deemed competent, on the basis of appropriate training and authorised assessment, to carry out the work to which the qualification pertains.

Rated Voltage

The manufacturer’s recommended maximum voltage that shall be applied to specified equipment.

Readily Accessible

A position where something is placed to ensure it is visible and easily accessed in an emergency.

Recloser

A form of circuit breaker, usually suitable for pole mounting, designed for a multi- shot operating sequence and with built in devices for fault sensing and reclosing.

Risk

The chance of something happening that has the potential to cause injury or harm the health of a person. It is measured in terms of consequences and likelihood.

Risk Management

Means the management of risk in accordance with Australian Standard AS 4360, Risk Management.

Safe Approach Distance (SAD)

Same as Minimum Approach Distance

Safe Working Load (SWL)

The maximum load (in kilograms [kgs]) which shall be applied to the specified equipment, apparatus or hardware.

Safety Assistant

Person qualified and accredited in LV rescue procedure, to be permitted to perform a rescue of a person in the presence of live Low Voltage.

Safety Observer

Means a person competent for the task and specifically assigned the duty of observing and warning against unsafe approach to electrical apparatus or other unsafe conditions.

Note. A Safety Observer may also be called a “Watcher or Spotter”.

Sectionaliser

An isolating switch, usually suitable for pole mounting, which is arranged to open automatically during a pre-selected dead time interval in the operating sequence of a controlling circuit breaker or recloser, on the occurrence of a sustained fault beyond the sectionaliser.

Secure

Free from or not exposed to danger, safe and not liable to fall or become displaced.

Secured

Lashing, clamping or otherwise fixing of the ladder to the structure against which the ladder has been placed or to some other “medium” close by such as trees, fence posts or stakes driven into the ground.

Service Line

The terminating span of an electric line ordinarily used for the supply of electricity at Low Voltage and through which electricity is, or is intended to be, supplied by a Network Service Provider to a Customer’s point of supply.

Shall

The word “shall” refers to MANDATORY requirements.

Should

The word “should” is used in a discretionary / advisory sense.

Test Permit

A documented form of authorisation that allows access to High Voltage apparatus for testing.

Tested

Apparatus which has been tested in accordance with the relevant Standard or work practice.

Test Voltage

The voltage which shall be applied to specified equipment for the purpose of periodic electrical testing.

Transformer

A plant or device that reduces or increases the voltage of alternating current.

Vicinity

Working in the vicinity of live electrical apparatus at distances up to the Vicinity Minimum Approach or Limits of Approach distances.

Voltage

The electronic force or electric potential between two points that give rise to the flow of electricity.

Voltage Transformer (VT)

A transformer for use with meters and / or protection devices in which the voltage across the secondary terminals is within prescribed error limits, proportional to the voltage across the primary terminals.

Work Area

The area within normal body reach of the line workers working position.

Working on

Touching conducting parts or working closer than at normal or special Minimum Approach or Limit of Approach distances.

3.0 ELECTRICAL AND WORK COMPLIANCE

3.1 Standards

Persons performing construction work on Hydro Tasmania Distribution Supply infrastructure must ensure design and quality of work complies with requirements of the following main documents:

TAS Networks Overhead Line Design Construction Standard

AS/NZS 7000 Overhead Line Design Standard

AS/NZS 3000 Wiring Rules and associated Standards

TAS Networks Service and Installation Rules

Tasnetworks Underground Design and Construction Standards

3.2 Access to Standards

As Tasmania's primary distribution network service organisation, TasNetworks provides Hydro with access to resources to maintain our overhead distribution networks. These documents can be accessed either via the TasNetworks internet (contractor page) or the Learning Management System (LMS) via Hydro's registration code: 11471.

3.3 Access to Perform Work

3.3.1 Process for Customer Notification

- Issue of a Planned Outage Notification.docx saved in BSI Shared Folders.

3.3.2 Access near UG Services

Where overhead infrastructure, such as power poles, will be installed near existing underground services where gas pipes are likely to be buried, the DIAL BEFORE YOU DIG 1100 process must be used before any excavation can occur.

Competency is required to locate underground services. If If an employee does not have full competency or ensurance in identifying essential services, a Hydro Tasmania or Private underground **Cable Locations Officer** to locate must be used, in accordance with the Concealed Services Permit and warn of underground cables and other services within the vicinity of the work zone.

Hand digging (also known as pot holing) must be performed to carefully locate where the cable or other underground services are before proceeding with major excavation e.g. using a pole hole borer erector unit.

3.4 Traffic Management

In general, employees and Service Providers shall comply with the Australian Traffic Standard AS 1742.3.

Employees must have "Implement Traffic Plan" accreditation enabling them to implement a Traffic Management Plan (TMP).

Where possible employees shall implement the non-complex TMPs provided by Hydro Tasmania by selecting an appropriate TMP from the Traffic Mgt. Selection Matrix.

Traffic Management Plans saved in BSI shared folders.

A Traffic Mgt. Contractor should be considered where a complex TMP is required e.g. at a major intersection, roundabout or, on a built up section of a highway.

The person in charge of the work site and in particular at a "rolling work site" where work is on the move (e.g. replacing a number of power poles along a road), must make sure," that:

- The correct traffic plan has been implemented, particularly if it is a plan provided by Hydro Tasmania. The traffic management keeps up with a moving site as work progresses (e.g. from pole to pole) and; work vehicles and mobile plant do not inadvertently move outside the area covered by the traffic management plan and;
- Visitors to the work site (e.g. Line Manager, Field Auditors, and Consultants etc.) are must comply with the traffic management plan requirements.

3.5 Network Risks

3.5.1 Street Light Control Circuits

Particular care shall be taken when work is performed near overhead control circuit wiring (street lighting circuits) as this wiring could become energised from another supply some distance away via activation through a time switch or photo electric cell.

While working on or near any street lighting control circuits, they must be treated as LIVE at all times. Appropriate live Low Voltage work procedures must be adopted where

applicable to minimise the risk of electric shock from work carried out remotely that could cause control circuit components to become live.

3.5.2 Back Feed from Customers

It is possible for voltage to inadvertently appear on LV overhead conductors due to customer activated generators or solar panels feeding some of the electricity generated back into the power grid.

Where there is any doubt that the overhead conductors could be inadvertently energised, isolation or live LV work practice methods shall be used to mitigate against this risk.

3.5.3 Live Structures

There is always a risk of aged apparatus such as insulators, deteriorating over time with insulation breakdown (fine cracks occurring) causing stray voltage to appear (e.g. where least expected down a wooden power pole). Where the supply has not been isolated, always test for stray voltage using a proximity tester before touching and working on a pole and associated assets.

If stray voltages are found, employees can perform follow up testing as per work practice to confirm if the voltage is sustained or induced voltage only.

3.5.4 Ferroresonance

The phenomenon of Ferroresonance results in high voltages that may occur when a modest size capacitance is either in series or in parallel, with non-linear inductance, such as an iron cored transformer. Ferroresonance is a condition that may occur on a three-phase system when:

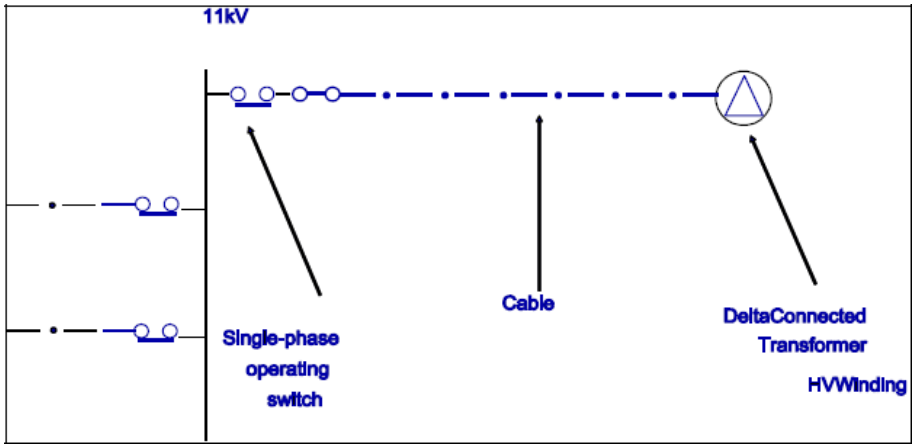
An unloaded delta/star distribution transformer becomes energised or de-energised by single-phase HV switching, and the length of underground cable exceeds the critical cable length for the transformer. For the critical cable length, see table below.

XLPE cable – Critical cable lengths (in metres) for ferroresonance

System voltage 11 kV					
Transformer (kVA)	Cable size				
	35 mm²	95 mm²	185 mm²	240 mm²	400 mm²
63	17 m	12 m	9 m	8 m	7 m
160	43 m	30 m	24 m	21 m	17 m
315	84 m	59 m	46 m	41 m	33 m
500	133 m	93 m	74 m	64 m	52 m
630	168 m	117 m	93 m	81 m	65 m
1000	267 m	186 m	146 m	129 m	104 m

The simplest form of occurrence of a ferroresonant circuit in a distribution system is when the single-phase operating switchgear or switch fuses are located some distance away from the transformer itself, with a length of underground cable joining the switchgear and transformer.

A circuit of this type could occur for example, where a substation is considerable distance from a switching station with the switchgear at the switching station being single-phase operated, as shown in the following example diagram.



To eliminate the occurrence of ferroresonance while switching, always energise and de-energise via three-phase devices simultaneously (e.g. load break switch).

Where a transformer can be energised with single phase devices (EDO's) on a length of underground cable, always isolate the transformer before energising the cable.

3.6 Working in Adverse Conditions

3.6.1 Safety and access

In some instances during severe weather conditions it is not safe for our crews to work. Powerline repairs may take longer as crews need to assess the risk before they can start restoration efforts.

The following conditions and safety issues can delay restoration efforts: Heavy rain, flooding, storms and windy conditions can impact access to power infrastructure and safe operation of Elevated Work Platform (EWPs). Crews are not permitted to work aloft on power poles if there is an electrical storm present. Crews cannot work aloft on power poles or on elevated work platforms in strong winds - Hydro Tasmania working at heights procedure.

3.6.2 Electrical storms – Work on OH lines & apparatus

Whenever there is visible lightning judged to be within a distance which could impact the worksite, work shall cease immediately with all members of the work party to seek shelter at ground level.

3.6.3 Wind forces

Wind is a major hazard when it comes to EWP operation. Wind forces increase in proportion to the square of the speed. If the wind speed doubles, the force acting on an EWP is four times greater.

Strong winds create particularly hazardous conditions, causing unsecured materials to be dislodged and uplifted. Wet and windy weather can also affect driving and the safe operation of mobile plant due to reduced visibility.

3.6.4 Restoring supply in order of priority

Our plans emphasise public and employee safety, the protection of our assets and restoration of power supply. Assessing damages to our network is conducted timely and accurately once the storm or threat has passed, in the following order.

- Safety first: for our crews and the public;
- Restoration of supply to essential services such as hospitals and community facilities;
- Restoration of supply to the largest number of customers as effectively as possible; and
- Repairs are then made to distribution transformers and finally, service wires to individual homes and businesses.

Note: Life support customers are to be treated as a priority - they're not an emergency hence the focus on essential services.

3.6.5 Use of EWP's in high wind conditions

Care needs to be taken not to exceed the maximum wind speed rating (should be marked on the mobile plant) when operating mobile plant, such as EWPs and Prolines etc., especially where booms are extended when working near energised apparatus. The wind speed standards in the operating manual for each EWP must be applied to manage the risk of falls and asset damage in wind.

3.6.6 Measuring wind speed

An anemometer is an accurate way of measuring wind speed. Anemometers are to be utilised at the worksite. The device should be open to the wind and checked at regular intervals (from the basket) as you elevate.

3.7 Insulating Material

3.7.1 General Requirements

There are various types of insulating mats and covers used in live electrical environments in different applications but for the same reason - to provide an electrically safe barrier from equipment or personnel working in the vicinity of live LV apparatus.

3.7.2 Insulating Covers and Pipes (Mats)

Mats are not treated as an insulating medium for intentional contact when working on adjacent live conductors, they are usedto prevent inadvertent or accidental contact when working. Workers should not lean over or against insulating barriers. Working from below the energised conductors or apparatus at no greater than head height is required to avoid collapsing across exposed energised mains.

Insulating covers and pipes (hoses) are used on overhead low voltage conductors and apparatus. As these covers and pipes are NOT required to undergo any electrical testing it is important for the safety of the Line Worker that they be in a sound condition. For further information refer to Australian Standard AS 4202.

Mats are installed from below the conductors - all work is conducted from below minimising the risk of inadvertent contact with adjacent live parts. Sound practice is to position Insulating Barriers for the duration of the task. The practice of continuously relocating Insulating Barriers may result in inadequate protection for the worker.

Work from a position where any contact with electricity would require a deliberate movement to touch energised parts or create a current path. In any situation where two or more people are working close to each other on live electrical equipment, they must take care not to touch one another directly or indirectly (for example do not pass conductive tools or objects directly from one to the other).

Learn to work with both hands together. Do not hold onto a conductor and reach elsewhere with the other hand. Check regularly that you are not making a second point of contact, particularly on establishing a new work position..

3.7.3 Applying LV Insulating Barriers General

- Secure all Insulating Barriers with Velcro, Pegs or clips:
- Overlap Insulating Barriers a minimum of 100mm; and
- Apply Initial Insulating Barriers from a position below the conductors.

Take care not to:

- Cause clashing of energised conductors;
- Make your body part of the circuit;
- Drop conductive tools across energised conductors;
- Initiate arcs when opening or closing circuits. Use firm, definite actions.

Cover and "Treat as Live"

3.7.4 Insulating Ground Mats

Insulating mats are used for covering low voltage electrical apparatus in substations, covering underground cables, wrapping around poles or laying on the ground at the base of a switchboard, meter panel, underground turret, streetlights, etc. For further information refer to Australian Standard AS/NZS 2978.

NOTE. These "mats" MUST be electrically tested annually.

3.8 Correct Use of Safety Harness

3.8.1 Working At Height on Poles

Working at height on poles needs to be managed in accordance with the hierarchy of controls. This involves working at ground level whenever possible (using insulated sticks or dressing poles at ground level - elimination); if not reasonable, using an EWP (engineering); if not reasonable, using a ladder and/or pole chair (engineering); having drop zones to minimise harm from falling objects (isolation); and using PPE (harness, lanyard, clothing etc) and administration controls (training, work practices, supervision and agreed communication before entering drop zones).

With the exception of condemned poles that must not be climbed and special requirements for private poles, Hydro Tasmania owned poles including staked poles and untreated wood poles are considered SAFE to climb subject to rigorously testing the integrity of each pole via an inspection, before affixing a ladder to the pole and ascending to perform work.

3.8.2 Check Stability of Pole

Test the pole by:

- "Sounding" with a hammer or the back of an axe, around the pole from ground level up to a height of approximately 2.0 metres;

- Check pole surface near the ground line with a screwdriver and closely examine for signs of decay or deterioration; and

  Note. Poles that have been staked or re-instated by other approved methods should be inspected as above. An additional examination of the steel section for obvious defects should also be made where any doubt may exist.

- Pushing along the line of conductors is ineffective;
- Bouncing on the ladder when ascending is unsafe; and
- Immediately stop testing a pole that shows signs of failure - don't climb until it is made safe.

3.8.3 Supporting a Pole

Attach temporary rope stays and secure them to suitable anchorage points, stake it or hold securely with a crane.

3.8.4 Monitoring Pole Condition

After proving the pole "sound" and climbing, remember that load conditions at the top will continue to alter due to worker and conductor tension which may affect its stability.

Continually check for any changes in stability and take appropriate remedial action as and when required.

3.8.5 If Safe To Climb Pole

Position and secure an approved extension ladder against the pole.

Ensure the ladder can't slip. Tie the ladder or, if this is not practically possible, have the "assistant" hold and foot the ladder before climbing. Tie ladder off on the first ascent. Do the "reverse" when descending. When a ladder is positioned against a pole – the top of the ladder must be tied off to the pole.

- Secure means to be "free from or not exposed to danger / safe / not liable to fall or become displaced";
- Employees required to perform work on poles shall use "restrained fall arrest" which is achieved through the use of a Line Worker's safety harness, with an approved lanyard fitted around the pole or ladder as the case may be;
- Where obstructions or other factors prevent the use of restrained fall arrest, then limited free fall arrest or full free fall arrest shall be used until such time as restrained fall arrest can be resumed;
- Position the lanyard around the pole or structure when in the working position. The lanyard can be fastened around the ladder – provided the ladder is correctly positioned and secured to the pole;
- Maintain "attachment" at all times except where gaining access via a portable ladder. Face the ladder when climbing and grasp the stiles with "both" hands; and
- Always use the right ladder for the job and in the correct manner. Never over reach above or to the sides of the ladder as you can overbalance and fall.

3.8.6 Standing on a Pole Chair

Although preference is to work out of an EWP or from a ladder a person can perform work standing on a pole chair provided that the person complies with the work practice for use of temporary pole chairs.

3.8.7 Pole Operating Platforms

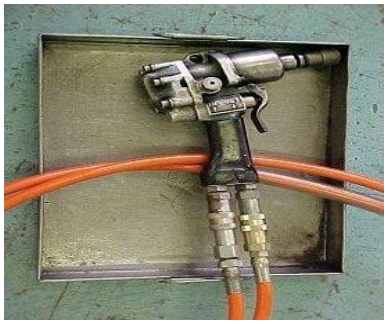
Hydro Tasmania has deemed that no employee or Service Provider employee shall stand on a pole operating platform as those in service are structurally unsafe.

A program of work is in place to remove all old pole operating platforms as per the work practice.

3.9 Hazardous Substances

Hazardous substances, such as transformer oil, asbestos, fuses and copper chromated arsenate pole ash, need to be handled and disposed of in accordance Hazardous Chemical Management Procedure and the Environmental Handbook and associated training.

3.9.1 Hydraulic Fluid



Pre- operational safety checks should be conducted before using hydraulic tools, checking for oil leaks, inspection of safety guards, damage to hose connections or couplings and damage or abrasions to hydraulic hoses. This is important to guard against a leak that could spray near energised apparatus.

3.9.2 SF6 Gases

SF6 Gas is colourless and normally odourless and can be harmful to health if a significant amount is breathed in. SF6 must be carefully dealt with in accordance with Hydro Tasmania's SF6 Management procedure.

3.9.3 Asbestos

For overhead work on distribution network, asbestos can also be found in: the internal heat shielded wiring of old (pre 1965) street light heads; the seals of the choke box covers; substations; street light glass diffusers; iron clad fuses; the back panels of meter boxes; switchboards; conduits; arc chutes; fuse panels and some plant. It can also be naturally occurring in some areas of Tasmania, for example, serpentine rock.

People performing this work must have current asbestos awareness training and follow TasNetworks asbestos work practices for these topics. In all other circumstances, a specialist must be engaged.

4.0 TOOLS, PLANT AND EQUIPMENT

4.1 Ladders

4.1.1 General

"Portable ladders" can include trestle, single, step and extension ladders of the type that can be physically picked up and moved from one place to another manually; and

All ladders shall comply with the relevant requirements of the standards, including being suitable for electrical work and shall be free from structural defects that would render the ladder hazardous to the user.

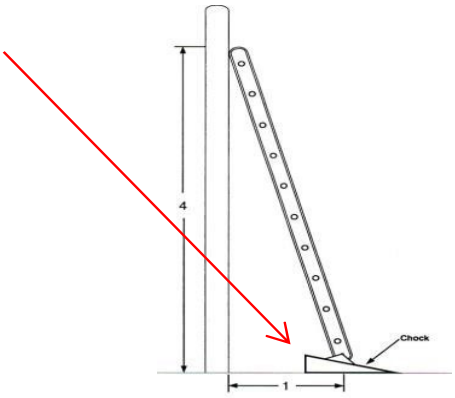
4.1.2 Single and Extension Type Ladders

When working in the field employees must comply with the work practice - Working at heights;

Additional requirements are:

- Ladders may be carried in a live switchyard – but only in a horizontal position and they must be carried so that no part is at any time above waist height;
- Correct use of Ladder Chock;

Preferred ladder angle is 4 metres up for every 1 metre out as shown



- Request assistance where any of the following conditions apply:

Extension ladders over 5 metres in length (closed up length) shall be carried, erected and lowered by at least two persons. Using shorter ladders in difficult situations or hazardous terrain. Using or moving ladders in LIVE switchyard or substation environments, two people are required to ENSURE it can be done safely. Erecting ladders in windy weather. Ascending and descending without the head rope secure, second person must foot the ladder. Secure means to be free from or not exposed to danger, to be safe, not liable to fall or become displaced;

- All ladders in "continuous" use should be thoroughly checked at least once a month;
- Position ladders against landings or roofs, with a minimum of 1 metre extending above the landing or roof;
- Secure bottom of ladder if there is any likelihood of slipping or moving. That is, foot, hold or tie off to a suitable anchorage point(s);

  Note. Suitable anchorage points can be: a pole, tree and a stake driven into the ground, house footings, pipes or anything a rope can be attached to that will not move and would be strong enough to hold the ladder secure.

- Secure top of ladders where they rest against structures / buildings. Tie off with a head rope where practicable. A ladder that cannot be tied off (e.g., leaning against a building)

shall be “secured” by some other means, while an employee is aloft. This may mean a person will need to foot and hold the ladder while it is elevated and being used;

- Ladder work should not be performed in high wind speeds, follow work at heights procedure;
- Face the ladder when ascending or descending and use both hands to climb, always maintain three points of contact;
- Position suitable barrier(s) around ladder(s) to maintain a safe work site if this is required;
- Only have one person on the ladder at any one time except in an emergency situation;
- Erect the ladder as close to the work as possible. A person on a ladder should never over reach, but instead should descend and relocate the ladder to a better working position;
- Remove mud, grease, etc. from footwear before climbing a ladder. Likewise keep ladder rungs and / or treads clean;
- Don’t stand on the “top” of ladders. A person’s feet must be at least “3” rungs from the top on single or extension ladders and at least “2” steps or treads from the top of step ladders;
- No one shall remove a ladder from a pole or structure when a person is aloft;
- When a ladder is required to be placed against framing or brittle material such as asbestos sheet or rough casting – a board should be fixed across the top of the ladder stiles to distribute the load evenly on the wall. A single stile can penetrate brittle material or be unstable against framing material; and
- Ladders placed in areas exposed to traffic (vehicular / pedestrian) must be protected against anything or anyone striking them, and should be conspicuously marked or barricaded off. If necessary, an employee should direct the traffic.

4.2 Come-a-longs (Rotors), Chain-Pulls and Similar Equipment

This type of equipment is used regularly for Line work. Inspection, maintenance and use of this equipment shall require employees to be classed as Dogman DG and Basic Rigger RB. Section 8.1, 8.2 of the HSEP0945 – Lifting and Rigging Procedure.

The following points shall be adhered to :-

- Be aware of the equipment's rated lifting / pulling capacity and never exceed it;
- Ensure that other equipment (slings, Dee shackles, etc.) used in conjunction with these pullers have a rated lifting capacity at least equal to the puller;
- When installing the puller, hang the body section first and then hang the chain hook. Ensure the body section ALWAYS hangs from the anchorage point such as cross arm, pole, etc. and NOT the other way around. Check the safety latches on the hooks are working correctly;
- When removing the puller, unhook the chain end first and then unhook the body section;
- Never fit pipe or such like over the handle of a puller to give greater purchasing power as this can damage the equipment and possibly cause it to fail;
- These items will form part of the lifting and rigging register, as per HSEP0945 6.5.18 Lifting and Rigging procedure.

Samples of Different Types of Pullers

Chain pullers are available in a range of styles, types and lifting capacities.

Some variations are:

- Ductile aluminium alloy or steel housing;
- Hardened steel alloy chain, wire or webbing strap;
- Lifting capacity 1/2 tonne to in excess of 5 tonne; and
- Single line or double line pull configuration.

4.2.1 Rope Blocks

- Rope and Chain Blocks are used for raising, lowering or moving heavy loads. For example; lifting apparatus on / off poles, straining conductors and lifting equipment on and off vehicles.
- They can also be used to haul equipment in awkward situations, eliminating the need for heavy physical effort and manual work by personnel.
- **Rope Blocks** have one or more pulley blocks reeved with rope, and it is important that the rope and the sheaves are matched. The correct size rope to fit the sheave must be used. The minimum size rope used by Hydro Tasmania = 12 mm diameter.

Inspection of Rope Blocks:

- Check the rope over its entire length, both inside and out.
- Check the outside for broken fibres, cuts, nicks, signs of abrasion, burns, flaying, or reduction in diameter.
- Check the inside - by untwisting the strands, looking for broken yarns, soiling, discolouration or a build-upof powder-like dust, which indicates excessive wear between the strands.

- Check the sheaves, hooks and associated attachments for rusting, cracks, distortion, deterioration, bending or jagged pieces. This is critical in any area where the rope can make contact as the rope can be CUT and fail.
- Check for loose pins or clips.
- Check for faulty or missing safety clips on the hooks.

Should any of the above be found, remove the "blocks" from service and have them repaired or replaced.

4.3 Insulated Hot Sticks

4.3.1 High Voltage Grip-All Clampstick

The Grip-All Clampstick, commonly called a "shotgun" stick, is used by Line workers to "clamp" onto various types of fittings, used for connection to high voltage conductors and apparatus. It can also be used, in conjunction with a "hook" arrangement, to operate various types of links and fuses.

The shotgun stick ensures a secure clamping method for connecting & disconnecting fittings from live conductors.

The operating mechanism incorporates a sliding hand grip that opens the hook to grasp a fitting eye screw and retract it into the tool head. A safety thumb latch must then be depressed to release the locked hand-grip so it can open the hook.

While the tool head is of an insulated material – the person using it must maintain the recommended safe working distance solely on the Epoxy glass pole section of the handle as the hook and its actuator are metal parts.

These grip-all sticks do not require field stripping to clean. All insulated parts are readily accessible to wipe dry or regularly clean with a silicone impregnated cloth.

Before each use, the Shotgun stick shall be examined for signs of cracks, surface damage or mechanical defects and shall be wiped thoroughly with a clean dry cloth.

Silicon cloth pads shall be used regularly to wipe the surface of each glass fibre operating stick to ensure the surface glazing is maintained in good condition.

4.3.2 High Voltage Operating (Hot) Sticks

The high voltage operating sticks come in a range of different styles and types.

"Telescoping" type sticks come in both circular and triangular configurations. The triangular shape, shown at right, is easier and quicker to extend and lock into position than the round one. It also tends to be more rigid when in use.

Telescoping types enable switchgear to be operated while standing on the ground at the base of the pole.

"Fixed length" type sticks are available with different heads attached. See below. These are for different operating activities.

All Operating sticks shall be examined before use for signs of cracks, surface damage or mechanical defects and shall be wiped thoroughly with a clean dry cloth.

Silicon cloth pads shall be used regularly to wipe the surface of each glass fibre operating stick to ensure the surface glazing is maintained in good condition.

NOTE: Operating sticks must be visually examined by an authorised person at intervals not exceeding six (6) months, and electrically tested every twelve (12) months as described in the Distribution Network Operation Manual.

The standard length of fixed length sticks used by Hydro Tasmania is 2.8 metres.

Outside the limited live line tasks, the shotgun stick or any other type of insulating hot stick must only be used for the purpose it was intended. The person using the insulating stick must ensure they do not breach the SADs they are authorised to work to.

4.3.3 Use of Talon Hooks

New Talon Disconnecting Hook

Current Disconnect Hook

- Talon Hooks can only be installed on the Extendable Operating Sticks. Talon hooks must be used for the removal and installation of EDOs when using an Extendable Operating Stick; and
- Short Operating Sticks can be used for removing and installing EDOs with the current Disconnect Hooks when working from a ladder or EWP.

  The current Disconnect Hooks can be used for other operations including Disconnecting and Reconnecting EDOs, Fuse Links and HV Links.

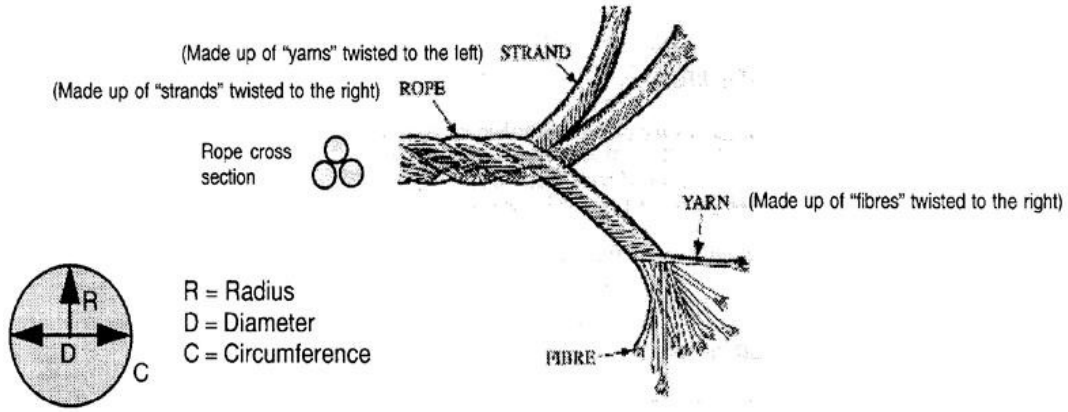
4.4 Natural and Synthetic Fibre Ropes

Ropes are generally constructed of natural or synthetic fibre being twisted together to make a yarn. Natural fibres come from plants, which include manila, sisal and hemp.

Synthetic fibres include nylon, polypropylene and various polyesters.

These yarns are further twisted to make a strand. Strands are then twisted in a right hand lay to make a rope.

4.4.1 Rope Construction:



These ropes are commonly used for: hand lines, in block and tackle sets or through snatch blocks to give a mechanical advantage when lifting or pulling loads.

4.4.2 Handling and Care of Fibre Ropes:

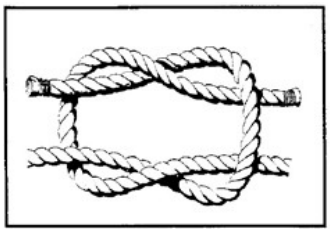
- Only approved fibre ropes shall be used and the correct type and size of rope must be selected to perform the job safely;
- Defective or damaged ropes must be removed from service;
- Ropes must not be overloaded;
- Ropes must be carefully inspected before using, for defects such as cuts, broken strands, wear or abrasion;
- Ropes must not be exposed to acids or acid fumes during use or storage;
- Sharp bending and kinking of ropes should be avoided. Square-edged objects must be padded;
- Knots must be used with caution because they can reduce the load carrying capacity of a rope by as much as 50%;
- Regularly inspect all rope and ensure it is free of grit infestation and any defects before use; and
- Ensure ropes are dry before storing away.

4.4.3 Knots and Their Application in Line Work

- The distinction between knots, bends and hitches is generally accepted as:
  - A "knot "is the intertwining of the end of a rope within a portion of the rope;
  - A "bend "is the intertwining of the ends of two ropes or the same rope to make one continuous rope or endless rope; and
  - A "hitch "is the attachment of a rope to a post, pole, ring, hook or other object.
- A good knot, bend or hitch is one that can be tied with speed and ease and which, when tied, will hold;
- A large percentage of overhead line work involves hauling of conductors, raising and lowering tools, equipment etc. The correct use of ropes and knots is essential; and
- A suitable knot for any application must be safe, simple, convenient, reliable, will not damage the rope or equipment and be easy to undo when the task is completed.

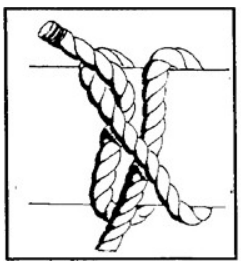
4.4.4 Reef Knot

- **Used in First Aid Applications -** Can be used to join ropes of equal or close to equal diameter; and
- **Method -** Pass left end over and under right end, reverse and pass right end over and under left end, then pull tight.



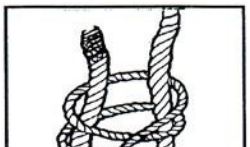
4.4.5 Clove Hitch

- **Used for tying ladders, strop or handline to pole.** Can be used to tie a handline to a pole, bar or similar round object; and
- **Method -** Make a turn round the object, lead therope up over itself & around a second turn, then bring the end of the rope under the crossing and pull tight.



4.4.6 Double Sheet Bend

- **Used for running/ pulling through conductors.**



Can be used for joining two ropes together.

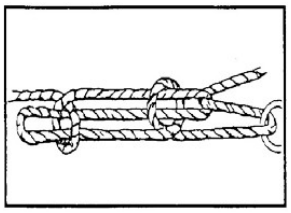
- **Method -** Form a bight in one rope or conductor, pass other rope through and around bight twice, then back out underneath the loop and pull tight.

4.4.7 Bowline

- **Used for hauling conductors to the pole top.** Can also be used to make a temporary loop in end of rope; and
- **Method -** Make an overhand loop in the rope. Bring the rope end up through this loop. Pass the end behind standing part, down through the same loop. Pull the end and loop tight

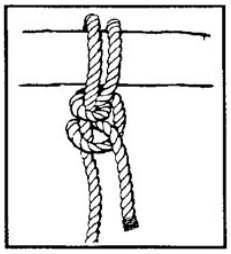
4.4.8 Sheep Shank

- **Used for temporary stays, tying down loads and for shortening up long ropes.** Can be used to temporary eliminate a weak spot in the rope; and
- **Method -** Gather loops of rope in length to be shortened. Make a half hitch with the standing part at each end and place over the loops and pull tight.



4.4.9 Fisherman's Bend

- **Used for lowering large limbs from trees.** Can also be used for tying ropes to rings, handles of buckets etc; and
- **Method -** Wrap rope twice around object. Pass tail around rope and through loops. Finish with half hitch on rope and pull tight.

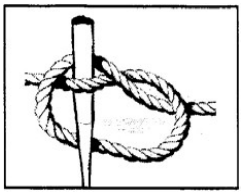


4.4.10 Becket or Buntline Hitch

- **Used for lowering small limbs from trees.** Can also be used to secure ends of tackles to beckets; and
- **Method -** Pass rope around object, over & around itself, then back over the loop. Pass tail around the rope & back through the loop and pull tight.

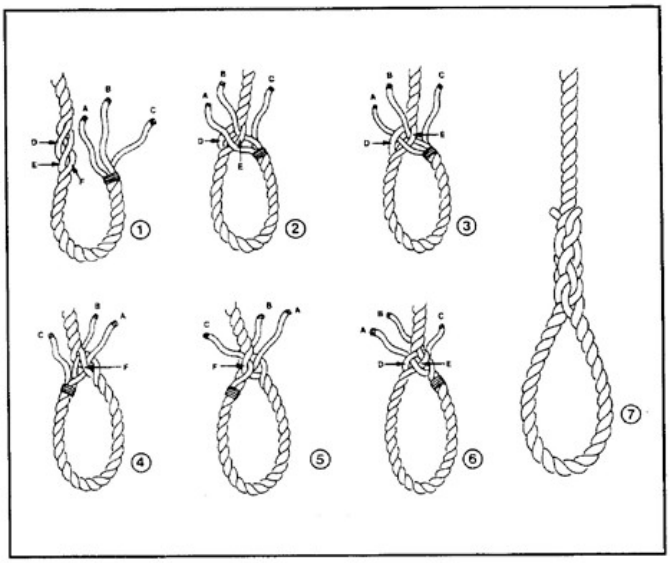
4.4.11 Lever or Marlinspike Hitch

- **Used for sending most equipment aloft on a handline; and**
- **Method -** Grasp rope with hand. Lift and twist forming a loop with tail under on top of rope. Pass object or tool through loop arrangement and pull tight.



4.4.12 Splicing and Whipping Used in Line Work

1. EYE SPLICE

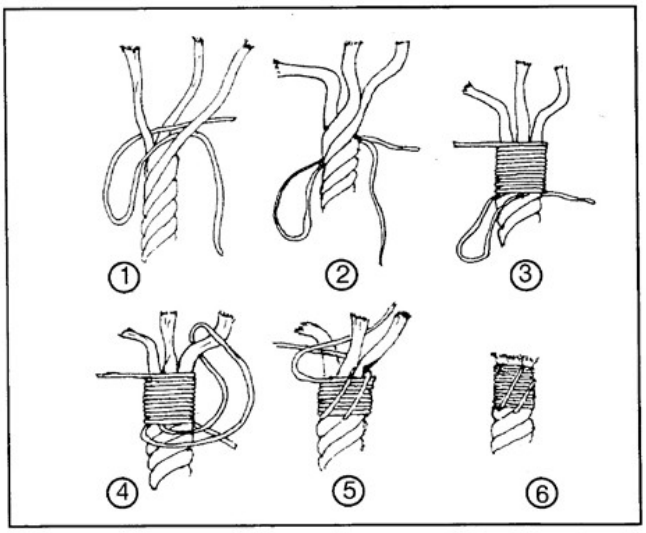


Used to form an eye in the end of rope for easy attachment.

Method :

1. Unlay strands A, B & C & tape/whip each end. Twist rope slightly to open up strands DEF of standing part of the rope.
2. Tuck end of middle strand B under the middle strand E of standing part of rope. Pull through.
3. Pass strand A over strand E & under strand D of standing part of rope.
4. Turn rope over to get at strand F.
5. Pass strand C over & under strand F as shown. Pull all three strands (A, B & C) in tight. (First round of tucks completed).
6. Pass strand B over strand D & under next strand to the left. Continue with A & C passing over one strand & under the next strand to the left.
7. Finish the splice by tucking each strand (A, B & C) once more through the rope.

2. SAIL MAKER'S WHIP



Used to lay hold of rope ends.

Method :

1. Unlay rope for approx. 50 mm with the centre strand away from you. Loop twine (as shown) with short tail 50 mm long and loop hanging down rope about 50 mm.
2. Relay three strands to original position.
3. Start wrapping long tail of twine around rope (from loop to top of rope) tightly & in opposite direction to lay of rope. Finish the whipping approx. 10 mm from rope end.
4. Following lay of rope, place loop over strand it was originally made around. Pull short tail of twine to tighten loop around the whipping.
5. Take short tail of twine up over whipping (following lay of rope) & tie both the tails together (reef knot) in middle of rope out of sight.
6. Cut off excessive tails of twine & fluff up the end of the rope.

4.5 Temporary Work Earths

4.5.1 General

When working on de-energised equipment, lines or apparatus, it is a safety requirement that temporary work earths shall be installed to maintain an equipotential worksite thus ensuring the safety of persons working on the equipment; and

Earths also protect against dangerous voltages becoming induced in equipment under repair.

REMEMBER: Temporary work earths shall only be attached to electrical conductors AFTER they have been proven de-energised and isolated.

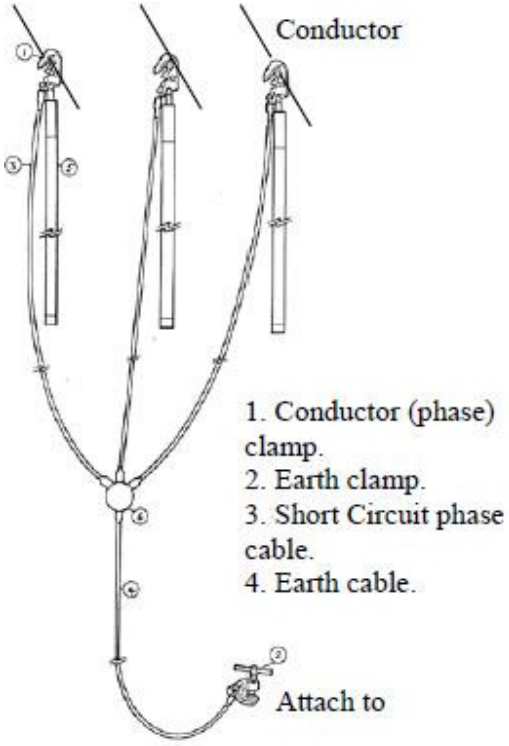
4.5.2 Portable Work Earths

The **earthing and short circuiting device** is a device permitting conductors to be earthed as well as short circuited. It comprises an earthing device and a short circuiting device.

The **earthing** part is for connecting the earthing system, or earth mass, to the short circuiting device and electrical installation equipment to be earthed.

The **short circuiting** part is for interconnecting conductors for short circuiting purposes.

The **applicator stick** is a hand-held insulating pole for bringing the connecting conductor clamps of portable work earths to parts of electrical installations for earthing and short circuiting purposes.



Operating personnel shall keep their hands BELOW the indicator point on the applicator stick to ensure they maintain the safe approach distance from potentially live apparatus. The earth clamp of the portable work earth may be connected to:

- A known recognised earthing system.
- A metal ground rod of an installed ground stay.
- An approved metal earthing rod driven, where practicable, 600mm into the ground "clear" of underground cables, water pipes, etc.

NOTE. Temporary earth connections should NOT be made to Air Break Switch handles or shafts.

Portable Work Earths must be periodically tested, inspected, tagged and disposed of if damaged as per the work guideline Care and Use of Portable Work Earths.

4.5.3 Earthing Arrangements and Attachments

When overhead conductors are earthed to a **recognised earthing system,** the earth connection clamp, shall be clamped to a permanent earthing attachment provided for the purpose, or to an earth wire by means of a suitable clamp or fitting.

Recognised earthing points are:

- A permanent HV earth provided for earthing purposes.

  (Recloser, Load Break, Circuit Breaker etc)
- A ganged isolator HV earth.
- A transformer HV earth.
- A pole stake if the earth fitting will connect securely.
- The steel rod of a ground stay.
- An approved metal earthing rod (1375 mm long) driven 600 mm into the ground.
- A trailing earth may be used as an option on moveable objects, such as a scaffold being used within a switchyard, to ensure the scaffold frame is earthed at all times to protect against induced voltages.

Earths shall NOT be attached to MEN earthing points.

A low voltage neutral earth system shall NOT be used as a temporary high voltage earth.

Earthing and short circuiting shall be installed at or within **sight of the work location**, except when the nature of the work renders this impracticable in which casethe earth connection(s) shall be placed as near as practicable to the work location. Either way - **they must be placed between the work location and all points of ISOLATION**.

When a HV system to be worked on is divided, or it has to be divided, the conductors on BOTH sides of the divided section shall be earthed and short circuited.

BOTH earthing "clamps" of the two sets of work earths shall be **connected to the ONE earth point**.

Note. In the case of a conductive, steel or concrete, pole – connect BOTH earths to the same point on the pole. Use an earth lug bolted to the pole in an approved manner.

Without using the second earth – a dangerous potential voltage, may otherwise exist between the earthed and unearthed conductors as a result of INDUCTION.

Sources of induction may be a considerable distance away and NOT evident at the work site.

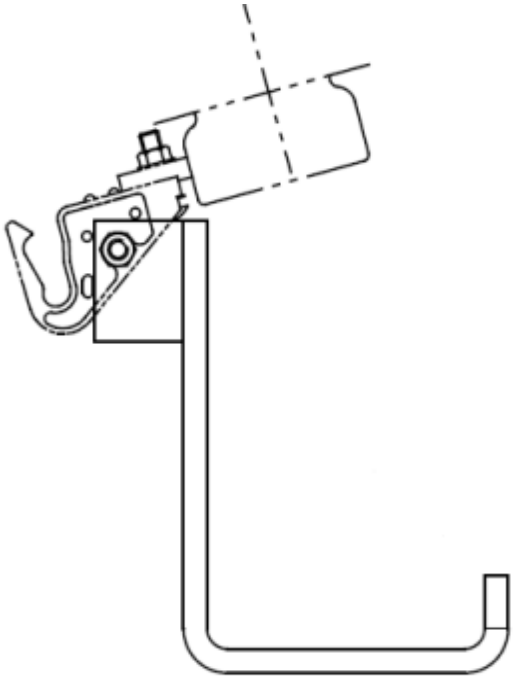
The same earthing and short circuit equipment may be used on copper or aluminium conductors provided the clamp connector used is at least 25mm and has a plain, not ridged, surface.

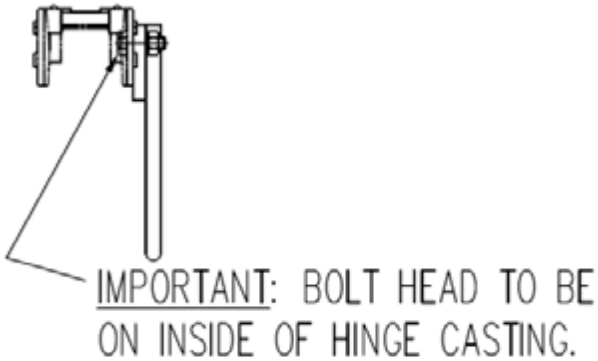
Wherever possible, apply the earths to a bridge, loop, in preference to a tensioned conductor. Do not over-tighten the clamp or the conductor may be damaged.

Do NOT apply earth "clamps" to helical terminations or conductor ties.

4.5.4 Safe Application of Earths

Earthing bolts will be replaced with earthing stirrups on NGK Series EDO assemblies opportunistically and on new planned work. The stirrup will increase the Safe Approach Distance (SAD) to greater than 700mm which is the required minimum. This will ensure that installing / uninstalling temporary earths does not encroach on the 700mm SADs minimum. NGK EDOs will now be supplied with the earthing stirrup, these are to be attached on the EDO before installing.





5.0 LINE WORK – CONSTRUCTION TASKS

5.1 Line Work

5.1.1 Distribution Poles Correct Hole Diameter and Depth

Where planned work is underway, details on correct pole type and depth of hole to be dug should be provided in the work details provided. If so, comply with what is provided.

Use the table below as a guide in conjunction with the above general factors, for selection of hole depth and diameter based on soil type and pole type.

If unsure; contact Design Section to clarify what is required.

Impregnated Wood Poles : **Table - 3**

Used for General Purpose Line work		
Pole Length & Strength	**Depth in Ground**	**Dry Mass of Pole**
8.0 metre – 6 kN.	**1.50** metres (line pole)	390 kg.
8.0 metre – 6 kN.	**1.80** metres (stay pole)	390 kg.
8.0 metre – 8 kN.	**1.80** metres	470 kg.
8.0 metre – 10 kN.	**1.80** metres	560 kg.
9.0 metre -- 4 kN.	**1.50** metres	400 kg.
9.0 metre – 6 kN.	**1.65** metres	540 kg.
9.0 metre – 8 kN.	**1.80** metres	665 kg.
10.5 metre – 4 kN.	**1.65** metres	525 kg.
10.5 metre – 6 kN.	**1.80** metres	705 kg.
10.5 metre – 8 kN.	**1.80** metres	850 kg.
12.0 metre – 4 kN.	**1.80** metres	665 kg.
12.0 metre – 6 kN.	**1.80** metres	875 kg.
12.0 metre – 8 kN.	**1.80** metres	1050 kg.
13.5 metre – 4 kN.	**2.00** metres	850 kg.
13.5 metre – 6 kN.	**2.00** metres	1090 kg.
13.5 metre – 8 kN.	**2.00** metres	1300 kg.
15.0 metre – 6 kN.	**2.10** metres	1175 kg.
15.0 metre – 8 kN.	**2.10** metres	1485 kg.
15.0 metre – 10 kN.	**2.10** metres	1720 kg.

5.1.2 Service Poles Depth and Footing Details

Shall be in accordance with the OH Construction Manual.

S/2kN SHS GI Steel Service Poles:

- All steel service poles shall be backfilled to full depth with wet pre mixed Rapid Set Cement, full batch to be prepared before pouring; and
- Support pole until cement sets before attaching service.

5.1.3 Hole Preparation

When sinking any type of hole, whether for a pole or a ground stay, it is important that the hole is excavated:

- In the correct location;
- The correct shape; and
- The correct depth.

The pole position is generally indicated by a wooden peg hammered in the ground or a painted mark on the footpath or kerb.

Although the proposed location for a pole should have been checked, care must be taken when sinking holes as there could be misplaced or undisclosed pipe or cable in the vicinity.

The width of the hole must be slightly larger than the size of the pole to allow for backfill and ramming. It must fit the size and shape of the pole.

Holes that are correctly dug - will make the installation of poles and stays much easier and ensure their long term stability.

Reduced depth will affect the strength and stability of a pole. A 20% reduction in depth can reduce the pole stability by 50%.

If a pole is not to be erected within a reasonable time of the hole being sunk, a cover board should be placed over the hole and in some instances, secured by pegging down or placing soil on top of it.

5.1.4 Using Excavators

Where a PHBE Pole Hole Borer Erector cannot be used (e.g. in rough terrain) then an Excavator can be used in accordance with the work practice.

5.2 Pole Types

Poles in various forms and sizes, and described in the following sections, are used to support overhead conductors, transformers, street lighting and associated equipment.

The Distribution Overhead Line Design and Construction Manual lists information about poles (type, size, strength, depth in ground, design data and so on).

Types of poles used by Hydro Tasmania are:

- Wood poles (treated); and
- Steel poles (various shapes & sizes).

5.2.1 Steel Poles

The OH Construction Manual shall be used as a guide to identify the different types of steel poles used.

5.2.2 Private Poles

Private poles on the BSI are inspected by Hydro Tasmania with defects requiring attention addressed to the customer.

5.3 Alignment of Poles

Poles are considered to be leaning excessively and require straightening if the pole leans by more than four top widths (pole heads) from the vertical. Poles to be straightened are usually those that Asset Inspectors have reported as requiring straightening. Poles must be straightened in accordance with the approved work practice.

5.4 Removing Poles

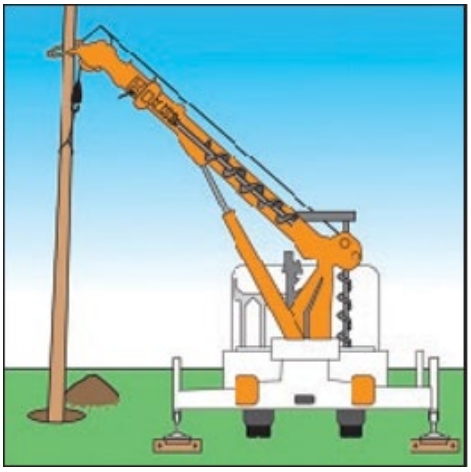
There are various reasons why poles are removed:

- Replacement due to deterioration;
- Replacement by a larger pole;
- Replacement due to redesign of roadways, etc; and
- Pole no longer required.

In the first case, additional care is required given the strength of a deteriorating pole is always suspect.

When removing a pole - it must be lowered, under full control until it reaches the ground or is stowed on the transporting vehicle.

A pole shall NOT be lowered using only the “jaws” on the boom of the Pole Hole Borer Erector unit. Poles shall be lowered via the crane hook attached to a sling, or chain, around the pole.



There are three ways in which poles can be recovered:

- Removal of complete pole, including the butt;
- Removal of pole leaving butt in the ground; and
- Removal of pole in sections.

5.4.1 Safe Use of Crane and Pole Jack

Poles shall be extracted by a Crane in conjunction with a Pole Jack.

Crane manufacturers typically state, “when a crane is to be used for extracting a pole the operation must be performed in conjunction with an approved pole extraction jack”.

The “force” necessary to break a pole free of the ground can exceed the SWL and is not readily known. Care must be exercised when attempting to extract poles. Where there is any resistance, a pole jack must be used in preference to trying to loosen a pole using slew functions of a crane.

Slewing left and right with a crane boom mechanism will cause expensive damage to the crane and other apparatus.

The purpose of the crane is only to support the pole and take its freely suspended weight.

5.4.2 Using PHBE and Jack

Removal of a pole is the reverse of installing, however there are additional constraints as follows:

- The operator must be careful not to exceed the lifting capacity of the PHBE crane. The safe working load of a typical winch rope on these vehicles is around 3.5 to 4.0 tonne. These values are easily exceeded even when extracting a non-concreted pole;
- The SWL of a PHBE unit fully extended can be as low as 0.5 tonne. It would be safer to break up the ground or dig out around the pole before attempting to lift the pole;
- Resistance to lifting, caused by friction of the pole foundation, WILL be in excess of the weight of the pole;
- With hydraulic equipment, by-pass valves are usually set to prevent overload, but this limiting device is not available on mechanically driven equipment;
- The pole’s point of balance cannot be accurately determined until the pole is out of the ground. Therefore, the winch rope should be attached to the pole as high as practicable for initial lift; and
- If the pole has deteriorated, there is always the risk of it breaking off.

To remove a complete pole:

- Support the pole with a crane;
- Ensure the lifting sling is above the balance point of the pole but low enough to allow the butt to clear the ground;
- Use a mechanical or hydraulic pole jack with a chain bound around the pole;
- Jack the butt out of the ground while the crane supports the pole; and
- Pole Jack instigates initial movement of the pole and the crane completes the lift.

5.4.3 Using an Excavator

An option that can be used, if it is not possible to get a PHBE to the site, is an Excavator to remove the pole, in accordance with safe work practices.

5.4.4 Disposing Of Poles

All poles removed from service should be disposed of thoughtfully and in accordance with our Waste Management Procedure.

Pressure impregnated poles must never be burnt and should be disposed of in accordance with environmental practices.

5.4.5 Impregnated Poles

Impregnated poles are treated with Copper Chrome Arsenate (CCA) preservative. The preservative chemicals are locked into the timber in an insoluble form and can only be released if the timber is burned.

The fumes released from burning CCA treated timber should NOT be inhaled. Should these fumes be inhaled in such volume to cause nausea or a feeling of sickness – contact the Poisons Information Centre and get prompt medical advice.

CCA treated timber should not be burned in barbecues, stoves or fire places, nor should it be left / used where children would play and could pick up splinters as this may allow an injection of arsenic. When CCA treated poles have been removed from the distribution system - DO NOT LEAVE THEM LYING ABOUT INDEFINITELY – as they could be cut up for use by persons unaware of the hazards involved in burning the CCA treated timber.

5.4.6 Re-use of Recovered Poles

Poles that have been in use and have been recovered must not be re-used until such time as they have been properly inspected or tested and proven to be in a good, sound condition.

All recovered poles should have the original ground line clearly marked and when re-installed, must not be set deeper than the original depth.

Recovered poles (over 10 years old) must not be re-used as supports in our overhead lines and newer poles, only after a test has proven them to be “sound”.

Recovered poles (over 15 years old) are not to be re-used as supports for any private overhead line.

Condemned poles must not be re-used for poles under any circumstances.

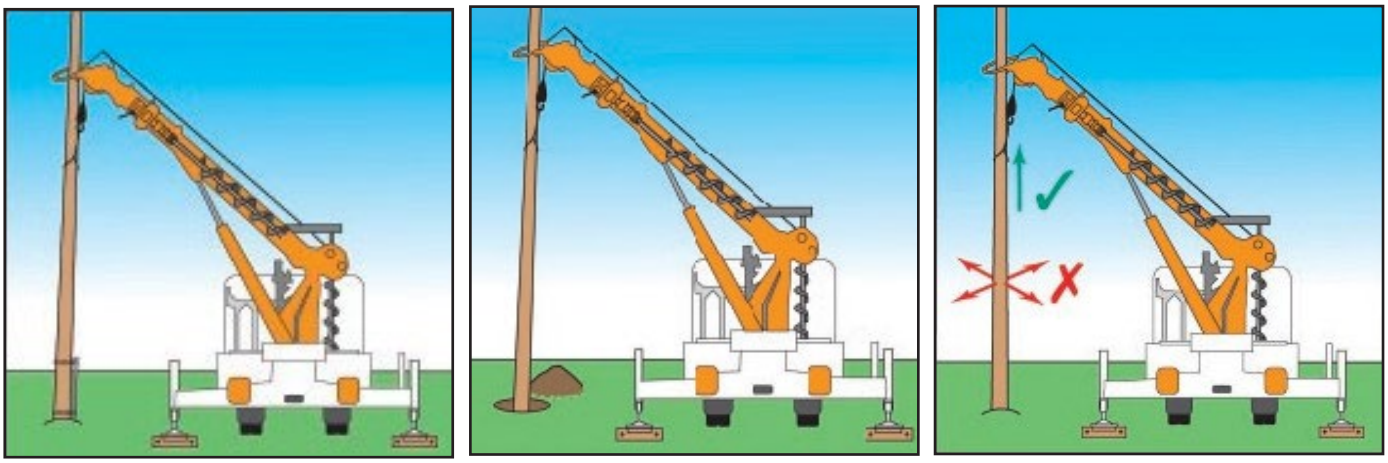
The removal of the butt or deteriorated section of a condemned pole designed to leave a shortened pole for re-use is not permitted.

The butt of a "sound" pole is not to be cut off to produce the required pole length. Any excess length is to be removed from the top of the pole and the pole recapped.

5.4.7 Lifting Poles

When lifting a pole, the lifting sling should be placed:

- Near the "point of balance" but just above that for manoeuvring into position;
- Closer to the head for actual erection; and
- The pole should be placed in the best position for direct lifting.



- Pole must be lowered under full control. No pole or section of pole shall be dropped.
- DO NOT use the pole grabs without winch rope taking load.
- DO NOT place load on the pole grabs when lowering pole.
- DO NOT exceed the SWL of the crane or lifting equipment.

Recovery of Full Pole

- Attach winch at a position which will ensure the butt clears the ground. Always use the hydraulic pole jacks or excavate to remove the pole.
- Ensure pole removal will not impact on other underground services (e.g. Dial before You Dig (DBYD), etc.)
- Fully support the pole before and while excavating. Use pole grabs to stabilise and support the pole.
- Pole may need to be removed in sections.
- Cover and spread any live conductors in the vicinity.
- DO NOT leave the concrete collar attached to the pole as a butt-weight.
- DO NOT use luff, slew or jib in/out to loosen the pole.

5.5 Pole Installation

5.5.1 Correct Backfilling and Ramming

Check clearances before backfilling

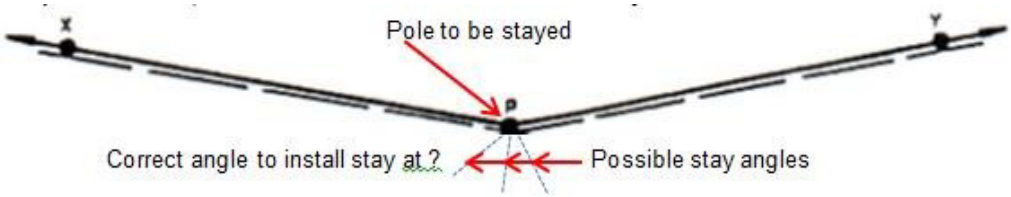
Solid ramming and tamping

- With any pole installation – it is IMPORTANT to backfill and "ram" the spoil correctly - packing tightly around the pole. Failure to do this can allow water to soak in and LOOSEN up the backfill allowing the pole to become loose in the hole and LEAN to one side. Rated pole strengths can ONLY be depended upon when the POLE FOOTING STRENGTH is adequate.
- Pole holes shall only be backfilled with the spoil removed if deemed quality e.g. gravel or dry clay. If the backfill is not good quality then fine crushed rock (FCR) or equivalent (e.g. gravel) will need to be used.
- Return the earth, where applicable, to the hole in such a way that the material which came out last goes back in first. This will ensure that the foundation material is adequate. It is of no benefit having the top-soil around the butt of the pole because it will not consolidate and the pole WILL move;
- Ram the pocket after the first 150mm of the back-fill has been returned and continue ramming in 150-200mm layers until the hole is filled. It consolidates easier and ensures a solid installation with very little subsidence;
- Form a mound of topsoil, about 150mm above ground level, around the pole, to allow for any sinking especially on footpaths and nature strips;

- The hole must be rammed evenly all around the pole as ramming only on one side has a tendency to turn the pole. If the pole turns, it should be held with a Cant Hook during the early ramming; and
- In many urban locations, crushed blue metal dust or Fine Crushed Rock (FCR) is usedto back fill holes. The material consolidates well and holds the poles securely.

5.5.2 Ground Stays

Where a stay is to be installed and there is a deviation in the angle of the overhead conductors to the pole, it is important to get the angle of the stay to the pole correct, refer to Overhead Construction Design Manual.



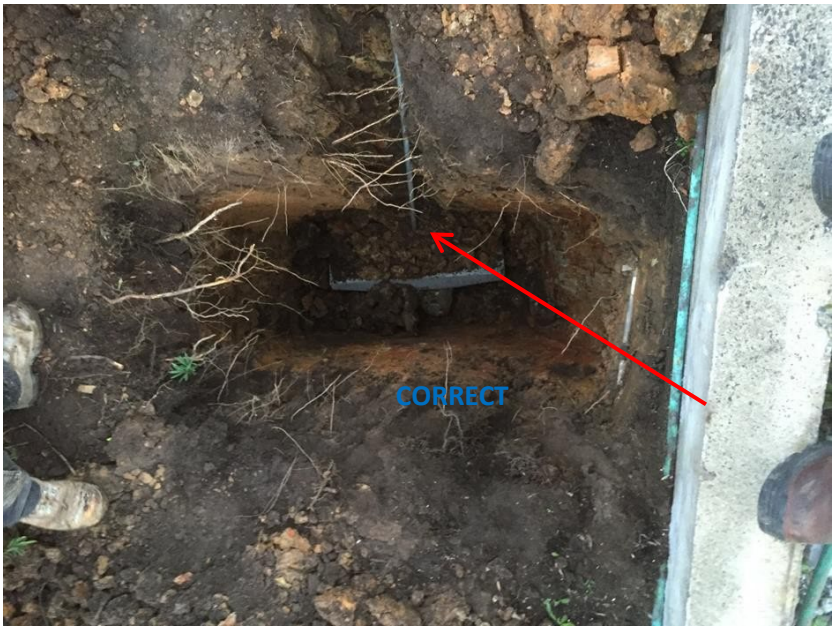
The “anchor” or stay rod will emerge from the ground at a distance from the pole equal to the height of the pole fixing for a 45° stay, and 3/5 or 0.6 times this distance for a 60° stay as shown in the following Diagram for an anchor block stay.

5.5.3 Anchor Block Ground Stay

The stay angles are measured from the horizontal plane to the stay line. The measurements mentioned above are for a level site and would need to be adjusted to suit sloping ground. The measurements will vary according to the length “H” (Height) of the pole.

Use of the 45° stay provides a suitable footing and imposes less vertical load on the pole. It is, therefore, preferable to use a 45° stay wherever there is room for it. It is particularly suitable for the termination of heavy conductors where soil conditions are doubtful.

The 60° stay does not extend as far from the pole and is used more frequently in built up areas where space behind the pole is limited. Anchor stays must not be installed vertically as this means the anchor block will not bite into the side wall and could easily be pulled out of the ground.

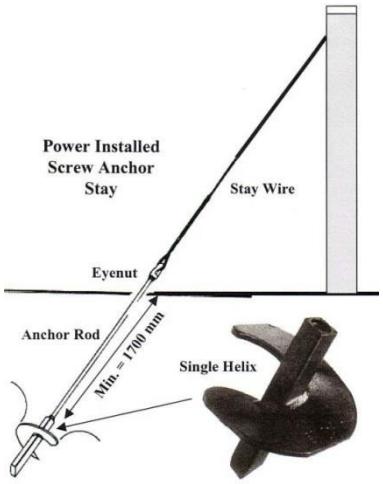


The correct method is to dig a groove into the hole at an angle so the stay rod will pull the anchor block at an angle allowing it to bite into the side wall as shown.

5.5.4 Screw in Anchor – Using PHBE

A screw anchor stay is as the name implies- SCREWED directly into the ground without having to dig a hole first.

The anchor is screwed in by a power screw anchor assembly fitted to a (PHBE).



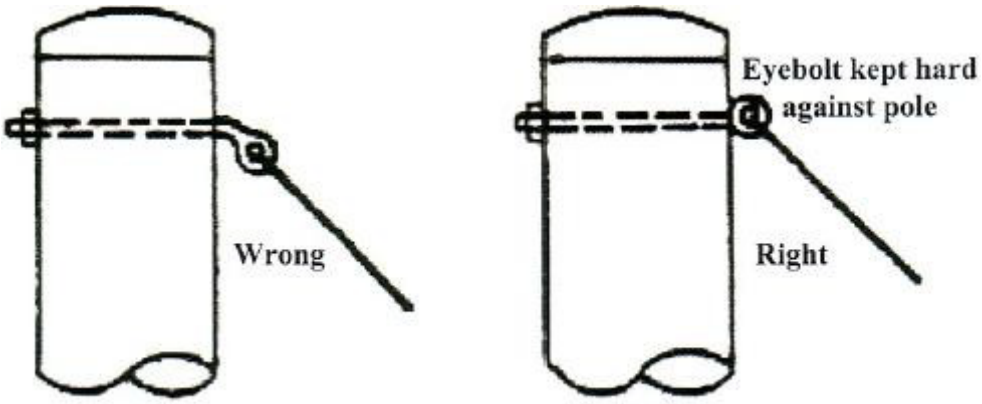
Refer to the Distribution Overhead Line Design and Construction Standard for detailed information on the screw anchors and the process for installing them.

Always be careful when straining a ground stay to a “screw anchor” as they have been known to fail in the ground.

When an eyebolt is used for fixing the stay to the pole, it is generally fitted as close below the conductors as possible. The position, however, varies according to circumstances but must be fitted into the pole as shown in the Diagram following.

If the eyebolt is left projecting from the pole, it will bend under strain and allow the stay to slacken off.

This will cause the pole to lean into the line and the conductors to drop, possibly BELOW the required ground clearance.



Method of Fitting Stay Eyebolt into Pole

When installing an anchor block stay - REMEMBER the following:

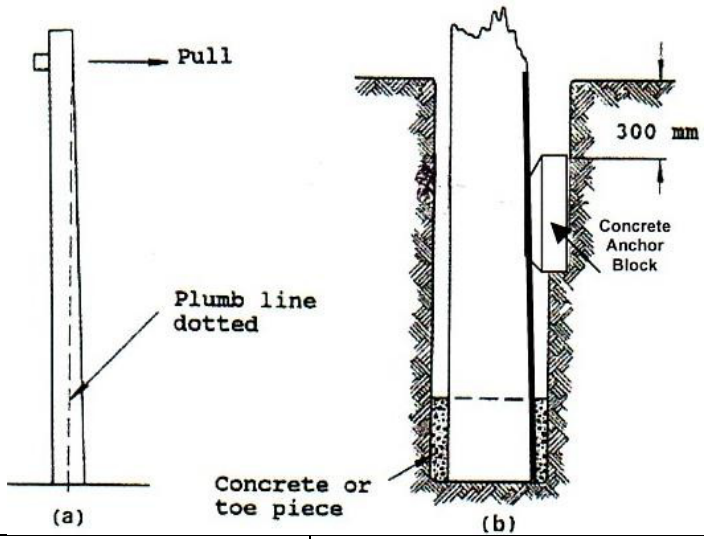
- Only one person to lower “block” into ground - holding the end of rod;
- Sight stay rod with pole eyebolt and pull anchor block hard up against the undercut portion of the hole; and
- Backfill hole and ram well.
- Always ensure that :
    - The ground rod is in a direct line with the stay eyebolt in the pole top;
    - Loose spoil is not left between anchor block and the undisturbed ground; and
    - If this is not adhered to, the loose spoil can be dislodged causing the stay to become slack. This will allow the pole to LEAN and the conductors to DROP.

5.5.5 Screw in Anchor – Using Excavator

Another option for screwing in an anchor stay is to use an excavator. For full details on this refer to the work practice.

5.5.6 Breast Logs and Toe Pieces

Breast logs and toe pieces are used to reinforce pole foundations of poles with minimal strain tension on the pole top, such as slack spans or very light conductors.



Drawing (a) shows pole pulled ½ pole back to allow for conductor tension.	Drawing (b) shows bottom section of pole in ground fitted with concrete toe piece and breast log.

Reinforcing the pole foundations by the method shown in Diagram (b) will not prevent bending of the pole towards the load (conductor tension) nor will it provide adequate support for heavy or tightly strung conductors.

Note. The other associated risk in installing poles WITHOUT a back stay is, when the pole deteriorates to the stage where the pole top forces are greater than the remaining strength in the pole, the pole can break off and fall over.

When the weight is applied to the pole top, the pole is securely wedged between the toe piece in the bottom of the hole and the breast plate. This method is not as good as "staying" but is effective for small line angles and lighter loads.

Installation method:

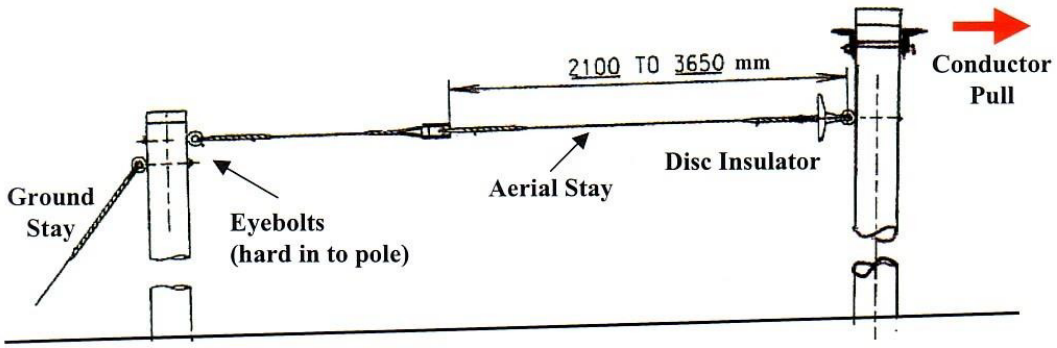
- Set the pole 1/2 its pole top diameter away from the direction the conductors will pull. See Diagram (a) above;
- Fit toe piece or concrete in hole against pole footing. The toe piece can be concrete or suitable rock(s);
- Position breast plate (concrete anchor block), on ground, against pole directly below the conductors and with the flat side outwards. Mark accurately around it, a tight fit is ESSENTIAL;
- Move the breast plate and dig out to a depth of the plate plus 300mm, keep the face straight and vertical; and
- Fit breast plate in hole against pole. Top of breast plate to be 300mm below ground level back fill hole and ram earth well.

5.5.7 Aerial Stays

In places where a back stay is impractical because of the need to cross a road or driveway or some other obstacle, an overhead (aerial) stay is used.

In this form of staying, a stay wire extends from near the top of the pole, to be stayed, to the top of another pole across the street at approximately the same height.

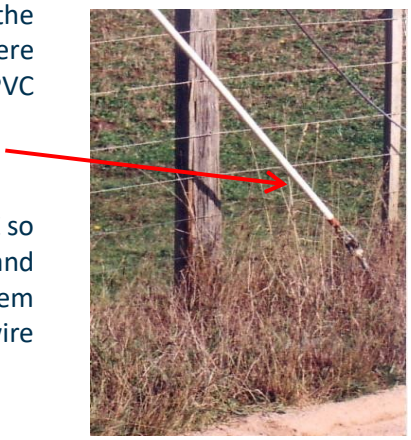
An aerial stay merely transfers the strain (tension) from one pole to another pole as shown in the following diagram.



In ALL instances, a ground stay has to be used in conjunction with an aerial stay as tension can exceed the footing strength of both the supporting pole and the aerial stay pole.

Stay Guards or Sighters

With the installation of ground stays, safety and welfare of the public is of primary concern. Therefore, in all areas where ground stays are installed they must be fitted with a white PVC guard or sighter.



These serve a dual purpose. They make the stay wire VISIBLE so as to prevent people, or animals, tripping over them and should they walk into the wire there is less chance of them being cut by it. The stay guard also protects the stay wire against damage from vehicles or vandals.

All stay "guards" MUST be secured to the stay wire by "clamping" or "tying" to PREVENT them being pulled off or pushed up the stay wire.

Clearances For Stays

Standards have been established regarding ground clearances for stays, just as for conductors.

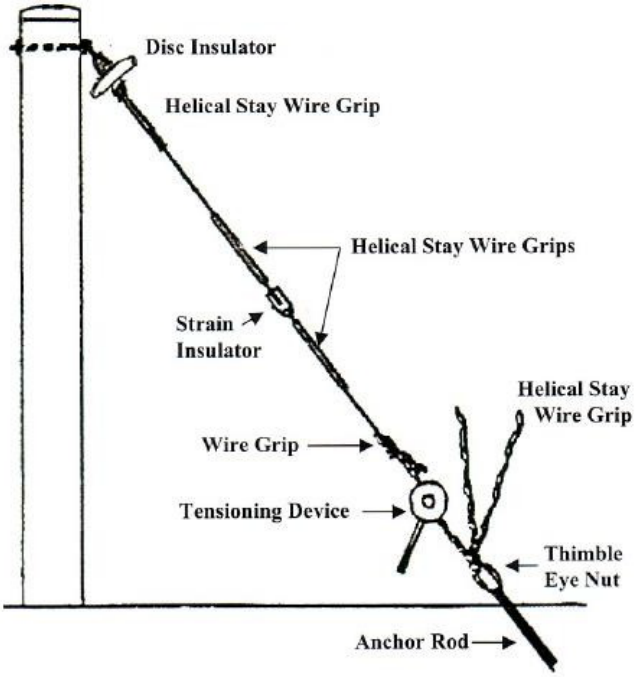
Minimum ground clearance of aerial stay wires:

Over roads or highways = 5.8 metres.
Over private driveways = 4.6 metres.
Over all other areas = 3.0 metres.

Minimum clearance in any direction between stay wires and conductors:

Low voltage conductors = 230mm (To Active conductor) = 150mm (To Neutral conductor). High voltage conductors = 460 mm (To 11 kV or 22 kV).

General Work Principles For Stays



With new work stays must be installed before the conductors are erected.

With reconstruction work, stays must be installed, or upgraded, before changes are made to the conductors. When installing stays, care must be taken not to place any excessive strain on the pole or the existing conductors.

Care must also be taken to prevent stays from contacting live conductors.

White stay "sighters" on ground stays. One "sighter" at the bottom near the ground and the second one at the top on the "bridle". For information on installation of this "second" sighter – refer to the Distribution Overhead Line Design & Construction Standard.

6.0 WORKING NEAR APPARATUS UNDER TENSION

When performing construction work and stringing conductors or working near conductors under tension, care must be taken to avoid the consequences from:

- Excessive strain suddenly breaking and releasing a conductor;
- Whiplash could result in a conductor striking someone or damaging apparatus;
- A person on the wrong side of a conductor and being pinned if holding apparatus (e.g. tie pin or stay wire) suddenly gives way; and
- Affixed pole or equipment suddenly shaking and possibly causing an issue if equipment breaks and falls down, or if a person is working off a ladder resting against the pole.

6.1 Work Likely to Introduce Sudden Significant Strain to Conductors.

The following construction work could produce a sudden significant strain and must be considered in a risk assessment.

- Straining of HV or LV conductors;
- Tensioning of stay wires;
- Straightening of a pole;
- Mounting and removal of pole type transformers, reclosers, etc;
- Fitting of or replacing live line clamps to conductors. **CAUTION** : With aged conductors there is a risk of conductor failure due to corrosion under the clamp; and
- Use of cranes etc. near overhead conductors.

When working with hard drawn conductors it is essential to:

- Be aware that these conductors can recoil quickly; and
- Be aware that if the ends of these conductors are not held firmly, they can flick UP, hitting you in the face or some other part of your body.

  Wear appropriate PPE when working with this type of conductor.

  - Safety glasses;
  - Safety helmet;
  - Good quality work gloves; and
  - Good quality work clothing.
- Properly clean the outer surface of aluminium conductor so it is FREE of aluminium oxide before making any electrical connection.
- Properly clean the outer surface of copper conductor to clear away the scaly surface (oxide coating) before making any electrical connection.

6.2 Pole Top Forces

When working with impaired poles, care must be taken to consider pole top forces (e.g. sudden release of conductors) causing pole tops or cross arms to break off. No one shall apply excessive force against the poles or lean anything up against the pole or affixed assets

(e.g. use of a ladder) or use the pole as a support, until a thorough written job risk assessment is carried out that includes testing the structural integrity of the pole.

6.2.1 Temporary Staying

There are times when a pole needs to be stayed temporarily, due to:

- The need to "secure" a pole beforeclimbing it.
- Releasing or temporarily removing conductors from one (1) side.
- Renewing conductors.
- Supporting a condemned pole with new pole beforechanging it over.

6.2.2 Releasing or temporarily removing conductors from one side.

A temporary stay must be attached to the pole BEFORE conductors are released / removed from one side of pole.

- A winch rope from a vehicle mounted winch.
- A wire rope fitted with an "eye" on each end attached to a vehicleor temporary ground anchor consisting of gads roped together.

CAUTION: All poles where overhead conductors (in tension) are to be temporarily removed from one side of the pole – must have a temporary stay installed that is capable of fully supporting the remaining conductor tension on the opposite side of the pole.

6.2.3 Renewing Conductors

The need to support poles when renewing conductors can vary with every job and the method required could vary from pole to pole depending whether remaining conductors are under tension or not.

Each pole would need to be considered on its own merits and a decision made as to the actual method applied at the time. Support a condemned pole with a new pole beforebefore changing it over.

Existing poles often need to be replaced with new poles. Where the old pole is "suspect" or condemned and CAN'T be replaced immediately, a new pole is installed beside it and the old pole made secure by supporting it with the new pole.

6.2.4 Assess Need to Use Support Stay

Before installing, stringing and tensioning conductors it may be necessary to install either a permanent stay (e.g. a back end stay) or a temporary stay (e.g. to counter the strain of conductors pulling at an angle to the pole).

6.2.5 Set Up For Stringing Conductors

- Where applicable, set up a safety drop zone to ensure persons cannot be struck by any conductor breaking under tension and falling to the ground;

- Conductors and cables must NOT be dragged across the ground or any other rough

surface as this can damage the conductor strands;

- Cable stringing rollers must be used to avoid damage to conductors and cables, you must ensure the gate on each roller used is securely closed;
- Rollers that have previously been used for copper conductors must be cleaned before running aluminium conductors to avoid any copper contamination of the aluminium conductors;
- Personnel must endeavour to make the most efficient use of conductor and cable in order to keep the number of joints to a minimum;
- The conductor stringing “sag” or “tension” shall be MEASURED and shall be in accordance with the stringing charts in the Distribution Overhead Line Design & Construction Standard (Section 3);
- Conductor terminations, ties and connections shall be as specified in the Distribution Overhead Line Design & Construction Standard;
- Termination dead ends shall be of the “preformed helical” type and single pin ties shall be of the preformed type; and
- Armour rods and vibration dampers may be required to be installed at positions nominated.

7.0 STRINGING CONDUCTORS

7.1 Laying Out Conductor

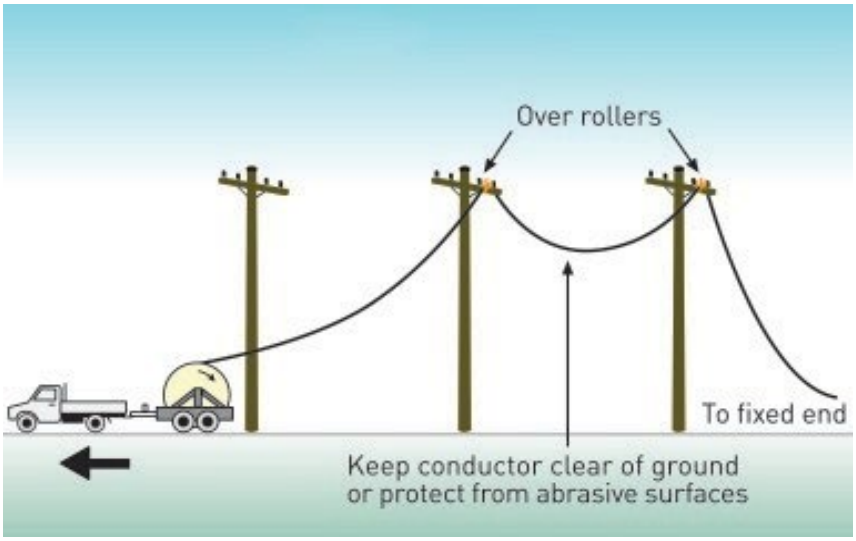
In the paying out method, the ends of the conductors are attached to the first pole, and then the cable drum trailer/truck is then slowly driven along the route paying-out the cable as it proceeds.

When large size conductors are being strung, the weight of the cable or the physical size of the drums often prevents all conductors being strung at the same time and it is necessary to travel the route of line several times.

On angle poles, stringing sheaves of the snatch block type may be used to allow the conductor free travel around the angle.

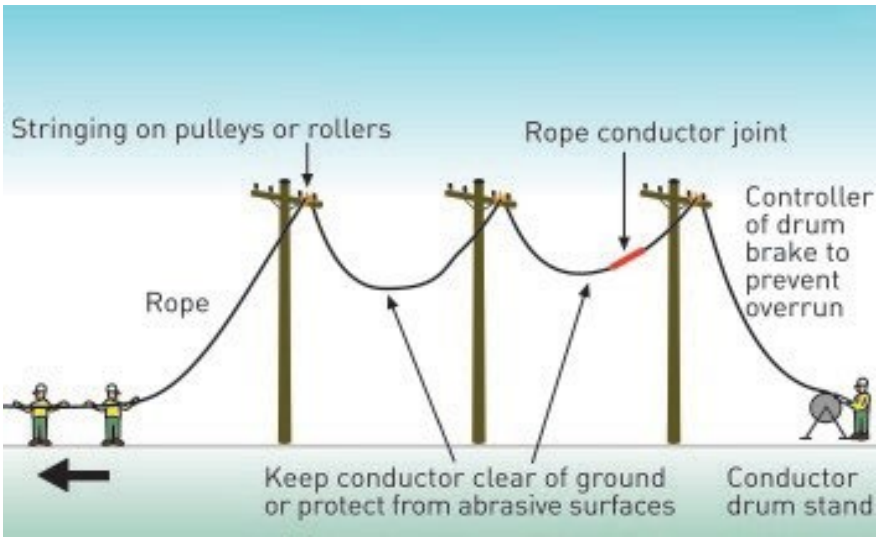
The cable is raised into the stringing rollers at each pole as the conductor is payed out.

This method is more applicable for new construction where line obstruction is not a problem and the terrain is more suitable.



To avoid injury when using rollers, make sure the gate is securely closed and wing nut is tightly done up.

7.1.1 Pulling in Method



The new conductor is pulled into place by the existing conductors or a draw rope. Where possible, always use a conductor swivel in conjunction with conductor attachment device to prevent conductor twist. Ensure swivel is of suitable diameter for conductor roller so it does not snag.

The cable drums are mounted on cradles at the start of each run. Inspect condition of existing conductor and joints for rust, damage and corrosion. The cradle should be placed on a level surface free from obstacles.

To prevent overrun, where possible, use cradles fitted with a braking & clutch device. Ensure the downward pull on the termination crossarm is not excessive.

On angle poles, stringing sheaves of the snatch block type may be used to allow the conductor free travel around the angle. Care must be taken to ensure that conductors are not dragged along the ground.

Observers are to be positioned along the route where particular hazards exist or to observe any joins as they pass through the roller and to stop the stringing if conductor gets caught.

Minimise the number of people aloft while pulling in takes place. Observers are to be positioned so that the whole of the section being run is visible.

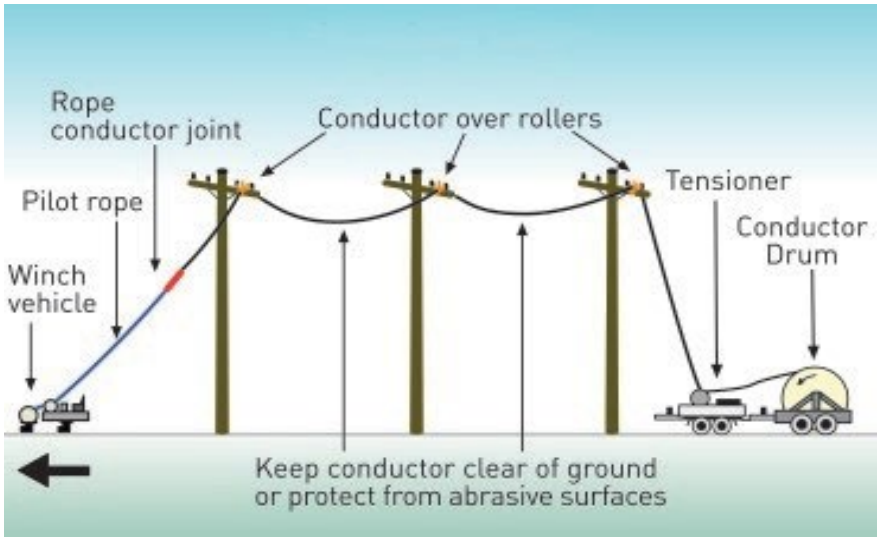
It is essential that there is good communication between these observers, the driver, and the cable drum operator.

DO NOT apply additional tension or shock loads to the draw conductor.

DO NOT use defective or damaged conductor as a draw wire unless slack stringing.

DO NOT attempt to release snagged conductors while under tension

7.1.2 Tension Stringing Method



The tension stringing method is also used where it is necessary to keep the conductors clear of obstacles, under crossings or busy roads.

The cable is mounted on a suitable stand or trailer and must have a braking device to keep cable clear of ground or obstacles during pulling in.

The conductor is to be pulled into place by the existing conductors or a draw rope, under tension, maintaining required clearances.

Where possible, always use a conductor swivel in conjunction with conductor attachment device to prevent conductor twist. Ensure swivel is of suitable diameter for conductor roller so it does not snag.

The other steps taken are similar to the pulling in method.

DO NOT attempt to release snagged conductors while under tension.

7.2 Set Up Ready to Strain Conductors

7.2.1 Signals for Use While Straining Conductors

When two way radios or phone systems are NOT available for pulling out and tensioning up conductors, it may be necessary to use approved “manual” signalling.

If this is the case - it is essential that a uniform system of signals be used, as there could be danger in the case of different signalling methods.

REMEMBER. Always be positive when making signals and avoid sending any confusing messages (signals).

Make your signals with the hand corresponding to the position of the conductors on the pole. If you want the right hand conductor (seen from your position) to be altered, use your right hand, and so on.

7.2.2 Straining / Sagging Conductors

Termination poles or poles with line angles must be stayed before the straining operation begins.

- For slack spans, or spans of small size conductor, it is possible to strain the conductor by hand using a hand line.
- For larger size conductors or conductors requiring a higher tension, it is necessary to use a mechanical straining device.
- It is necessary to provide an anchor for straining and some means of gripping the conductor without causing damage to it.
- Another method commonly used when straining high voltage conductors is to attach a straining device* to the ball socket clevis on the disc insulator. The tensioning device is then "hooked" into this straining device.

The approved straining devices for use are the following types:

Cast Iron Straining Device. **Safe Working Load = 10 KN**

An M16 x 75 mm bolt shall be used to bolt this "device" to the ball socket clevis as shown at right.

Uni-Directional Ring Bolt Device. **Safe Working Load = 14.8 KN** or **= 1.5 tonne**

An M16 x 100mm bolt shall be used to bolt this "device" to the ball socket clevis as shown at right.

Utilising a bridle.

This method uses a winch rope hooked to a snatch block fitted on a wirerope (long sling equaliser) connected to the ends of both conductors. The wire rope acts as an equaliser and pulls both conductors at the same time evening out the tension between the conductors.

Aluminium conductors must be protected from damage when straining up by using aluminium grips (comealongs) with smooth jaws.

If an aluminium grip is not available, a wrapping of armour tape around the conductor will protect the conductor. Preformed wrapons may also be used.

7.2.3 Confirm Correct Sag & KN kN Tension

The correct sag and tension will depend primarily on, the type of conductor (e.g. AL Al, or CUCu), conductor size and, the length of the span.

In addition, you must ensure sufficient ground clearance will be maintained in the worst conditions (e.g. when ambient temperature is 40° plus).

Comply with the relevant sag chart of the Overhead Line Design & Construction Manual.

7.2.4 Using a Sight Marker

Sagging “by sight” is an acceptable alternative to sagging conductors using a dynamometer. This is where a “SIGHT” marker is attached on two different poles at the required distance below where the conductors will eventually rest.

An employee “SIGHTS” between the two markers and has the conductor(s) raised or lowered until the lowest point in the conductor is LEVEL with the sight markers.

Note. Sagging by sight when using a sag chart should never be attempted on windy days because the tension in the conductors will be increased by the wind action which will result in the wrong results.

7.2.5 Using a Dynamometer

When conductors are required to be strained to “X” kilo newtons tension, a dynamometer is used.

A dynamometer indicates on the dial, the tension in the conductor when it is connected in line between the conductor being sagged and the tensioning equipment.

The dynamometer method of sagging conductors is the most effective way of ensuring that conductors are CORRECTLY tensioned for the pole top forces allowed for in line design and existing pole strengths.

8.0 SWITCHGEAR

8.1 Categories

Electrical apparatus is used throughout the distribution system to provide protection and control points for transferring load, managing and reducing fault levels, sectionalising faults, and providing isolation and control points for maintenance. Electrical apparatus includes all major items of distribution infrastructure such as open switches, fuses, reclosers, gas switches, surge diverters and voltage regulators.

Switches, of various types, are used to interrupt the power supply. With the exception of "enclosed" switches such as: Reclosers, Gas Switches - Pole mounted switchgear has the ability to carry load, but only limited ability according to its category to interrupt load.

Switchgear falls into four (4) main categories, these are:

(1). Fault make – Fault break.

- Circuit Breakers.
- Pole Mounted Reclosers.

(2). Fault make – Load break.

- Ground mounted Switch.
- Ground mounted Switch Fuse.
- Pole mounted Load Break Switch.

(3). Load make – Load break. ***Maximum operating kVA in following sections***

- Pole mounted Ganged Isolator (ABS).
- Pole mounted Fuses (EDO) – Light loads only.
- HV Links

(4). Isolators.

- By definition are a non-load break device.

Switches are divided into broad general classes related to the type of insulation medium, eg "air", "oil" and "gas" switches, "oil" and "gas" switches are the ENCLOSED type.

8.1.1 Reclosers (Fault Make – Fault Break)

A recloser is a pole mounted circuit breaker, which operates automatically under fault conditions, restoring supply after each trip until the fault clears, or "lock out" occurs.

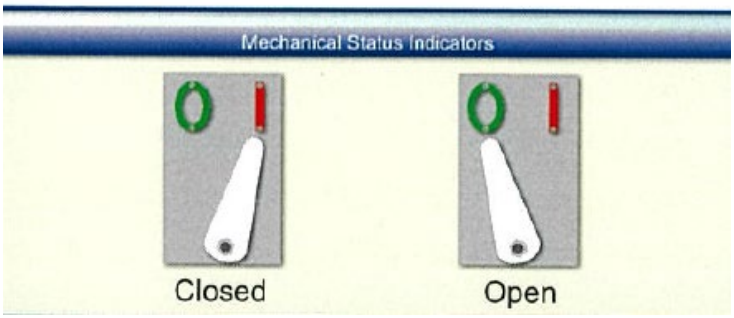
The use of reclosers results in fast restoration of supply after transient faults, reduces the number of customers affected by a fault and minimises interruption times by dividing long feeders into smaller sections.

A recloser can also be operated manually.

When set to “one trip to lock-out” this prevents reclosing after a protection operation.

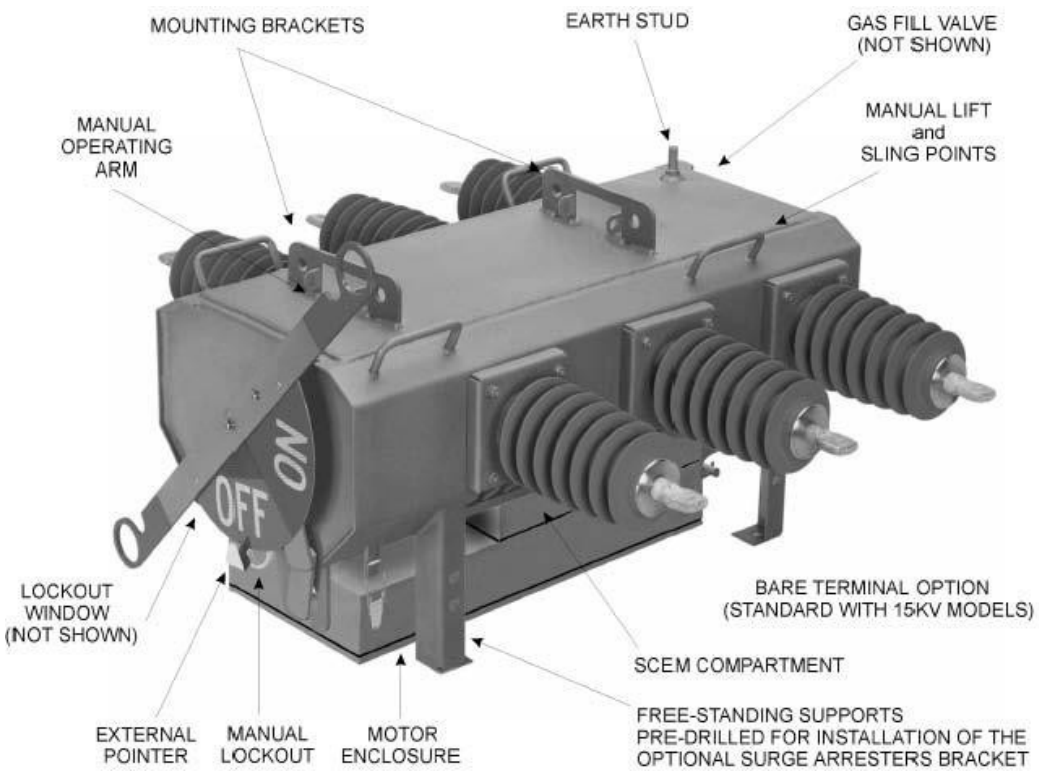
The Nulec Automatic Circuit Recloser (ACR), shown above is an electronically controlled pole mounted, GAS insulated, three (3) phase switch that is set up for REMOTE CONTROL operation. It can also be operated MANUALLY on- site if required. Vacuum interrupters, insulated by SF6 gas, enclosed in a sealed-for life stainless steel tank ensures a long, low maintenance service life. An Operator control panel is provided with the ACR for an Operator to operate the unit on-site.

- Confirm the recloser is fit for service prior to and after any operation.
- *The preferred method of operation, in order, is always as follows:*
  1. *Remote operation via SCADA.*
  2. *Local electrical operation.*
  3. *Manual Operation.*
- Note: This recloser cannot be closed manually.
- Refer to the NuLec N27 Circuit Recloser Control Box template for electrical operation instructions.



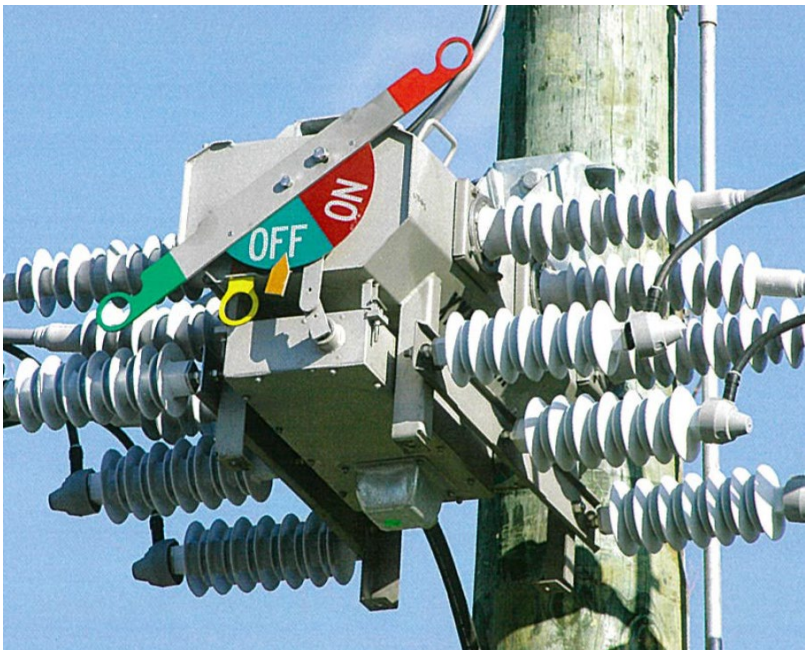
8.1.2 Load Break Switches / Sectionalisers (Fault Make – Load Break)

The Load Break Switch (LBS) is a pole mounted, GAS insulated, three (3) phase switch that is set up for REMOTE CONTROL operation. It can also be operated MANUALLY on-site if required.



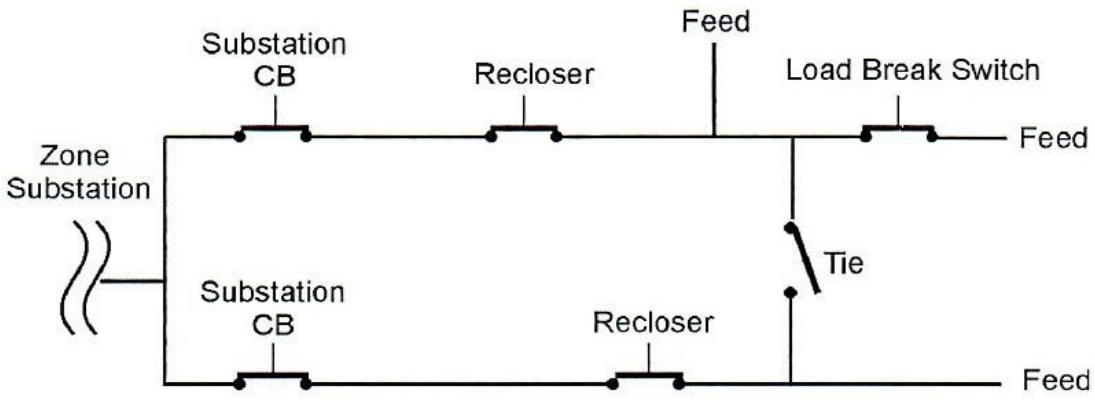
A puffer interruption system insulated by SF6 gas, enclosed in a sealedfor life stainless steel tank ensures a long, low maintenance service life. An Operator control panel is provided with the LBS to allow an Operator to operate the unit on-site.

The LBS is mounted on a single pole similar to the diagram shown below.



When the LBS “counts” the SET number of PRESET TRIPS of the “Recloser”, it will then automatically activate. This isolates the DOWNSTREAM “fault” from the network system and allows the UPSTREAM Recloser to restore supply to Feeder(s) upstream of the LBS.

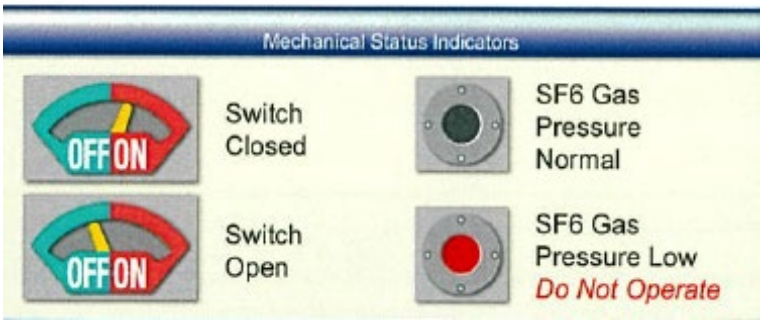
The diagram below of a simple network shows the relative positioning of a LBS “downstream” of a Recloser.



From the diagram above, it can be seen how a fault condition BEYOND the “LBS” can be isolated and supply restored by the Recloser to Feeder(s) upstream of it.

The “fault condition” MUST be rectified BEFORE the LBS closes back on to restore supply downstream.

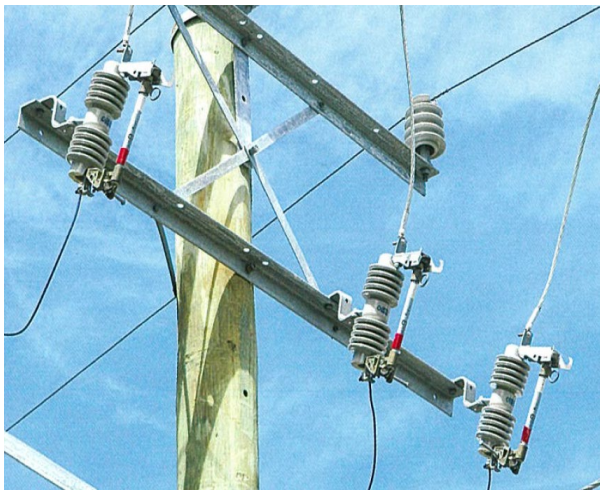
- Confirm the load break switch is fit for service prior to and after any operation.
- *The preferred method of operation, in order, is always as follows:*
  1. *Remote operation via SCADA.*
  2. *Local electrical operation.*
  3. *Manual Operation.*
- *Do not operate the load break switch if the SF6 gas pressure indicator is red.*
- Refer to the NuLec RL27 Load Break Switch - Sectionaliser Control Box template for electrical operation instructions.



8.1.3 Air Break Switches – BSI

Air Break Switches will no longer be used on the Bass Strait Islands. Replacement options are Load Break Switches and HV Links where identified.

8.1.4 Expulsion Drop Out (EDO) Fuses (Load Make – Load Break)



High Voltage EDO fuses are single phase devices, installed for protection of Distribution transformers and spur lines. The fuse switch drops open under fault conditions, isolating the faulty apparatus or section of line, whilst at the same time providing a clear indication of the fuse operation. Most commonly used are the expulsion drop out (EDO) fuse fitting similar to that shown.

Precaution

The risk of falling objects needs to be managed in accordance with Hydro's Safe Work Practices. Thorough inspection of the EDO assembly is required before operating from a ladder is permitted. However where the condition of an assembly is uncertain, consideration should be given to performing the operation from ground level utilising a telescopic stick.

Assembly failure when operating

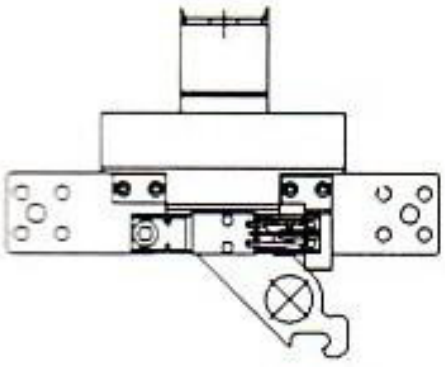
- Confirm the EDO fuses are fit for service prior to and after any operation.
- If a fuse element is to be replaced, ALL remaining fuse elements should be replaced at the same time.
- *Maximum Operating Rating 11kV - 600 connected kVA*
  Maximum Operating Rating 22kV - 1000 connected kVA
- *Fuses shall be operated in succession, in the following order, and as quickly as possible to minimise the effects of single phasing.*
  1. *Outside upwind*
  2. *Outside down wind*
  3. *Centre*
- For isolation fuses must be removed from the EDO holder.
- The EDO fuse should not be left hanging in the open position for extended periods of time as water may enter and damage the fuse tube.
- Refer to fuse tables for replacement fuse element ratings.
- *An approved operating stick shall only be used when operating EDO fuses. The operating stick must be in test and examined before use to ensure it is sound, dry and free from defects.*

8.1.5 High Voltage Links (Load Make – Load Break)

High Voltage links unlike the Air Break Switch where three blades open simultaneously, must be opened separately.

- Confirm the links are fit for service prior to and after any operation.
- Links without arc break devices should not be used to interrupt more than *600 connected kVA at 11kV* and *1000 connected kVA at 22kV.*
- Links with arc break devices should not be used to interrupt more than *1500 connected kVA at 11kV* and *3000 connected kVA at 22kV.*
- *Links shall be operated in succession, in the following order, and as quickly as possible to minimise the effects of single phasing.*
  1. *Outside upwind*
  2. *Outside down wind*
  3. *Centre*
- When opening, links must be fully opened to ensure maximum separation.
- Horizontal link blades must be opened past the vertical plane to ensure against accidental closing.
- Approved operating sticks only shall be used and must be in test and examined before use to ensure that they are sound, dry and free from defects.

8.1.6 Low Voltage Links



These are used as switches for connecting or disconnecting sections of low voltage mains.

They are normally fitted to poles between low voltage circuits of adjacent substations as a means of making and breaking parallel connections.

Low Voltage Links are used as isolators only and should not be used to break large currents.

8.1.7 Distribution Mains Fuses LV

Low Voltage fuses are connected into low voltage mains and services to protect them from fault current. The type of fuse most commonly used is the “HRC” or High Rupture Capacity, LV fuses are installed on transformers to protect against:

- Thermal damage to the transformer.
- Thermal damage to cable insulation.
- Annealing of the conductor.
- Mechanical damage to the cable.
- Risk of electric shock to personnel and the public.

9.0 EARTHING SYSTEMS

9.1 General

- Provide additional protection to minimise the chance of persons receiving an electric shock if an electrical fault occurs; and
- When connected as an earth mat arrangement (e.g. in a switchyard) provides protection against step and touch potential by keeping voltage differential between conductive surfaces as close as possible to zero. The earth wire is connected to the mass of earth via connection to an earth rod (or via bonding to a steel pole or as an earth mat) buried into the ground to provide a low resistance path for fault current.

9.1.1 Multiple Earthed Neutral (MEN) System

Multiple Earthed Neutral (MEN) means a system of earthing in which the parts of an installation required to be earthed are connected to the general mass of earth and are connected within the installation, to the neutral conductor of the supply system.

The (MEN) is the main system of earthing used in electrical circuits in the Power Distribution System and also in customer installations. In the M.E.N. system, the earth and neutral are connected together at the Customer's switchboard.

In the (MEN) system, fault current returns through the neutral conductor as shown in the Diagram below. The neutral conductor is connected to earth at various pole positions [typically every third or fourth span] in order to maintain the neutral at earth potential. Intermediate earths are connected to the LV neutral conductor, but HV and LV earths are electrically separated at the transformer.

9.1.2 Reference Earth Tables

Minimum earth resistance for common distribution arrangements

Transformer High Voltage Earth	30Ω
Transformer Low Voltage Earth up to 63kVA	30Ω
Transformer Low Voltage Earth over 63 kVA and up to 500 kVA	15Ω
Operational Earth (HV)	30Ω
Air Break Switch & Handle Earth	10 Ω
Recloser (HV)	10 Ω
RL 27 Load Break Switch	10 Ω
HV Underground Cables earth screen.	30 Ω
HV ABC and Steel Catenary	10 Ω
Lightning Arrestors	10 Ω

10.0 POLE MOUNTED TRANSFORMERS

10.1 Replacing an existing pole mounted transformer:

- All new three phase and single phase replacement transformers, regardless of kVA rating must have arrestors installed for protection against lightning strike;
- Where transformer LV output isolating links had been previously installed, these must be replaced with an appropriately rated set of HRC fuses and fittings;
- Non-standard pole mounted transformer installations must be brought up to standard when a transformer is being replaced. All customer neutrals must be connected to the distribution neutral;
- HV and LV earths must be tested in accordance with the work practice Standard Earth Tests in the Power Distribution System before energisation of the transformer. Should any earth value be outside the maximum allowed limit, you must follow the requirements detailed in this work practice;
- This may require the transformer to be left de-energised and the earth repaired in accordance with work practices and a re-test performed, confirming earth values are correct before energisation and commissioning; and
- All earth wires running down the pole must have an earth cover guard affixed as per work instruction.

10.1.1 Surge Diverters (Lightning Arrestors)

- All new pole mounted transformers are now supplied with lightning arrestors already fitted ready for installation; and
- In the past transformers may have been installed without lightning arrestors fitted. When any transformer is replaced the new transformer (including refurbished) must have lightning arrestors fitted.

10.1.2 Mounting Transformers

Methods for mounting transformers on poles:

- Bolting them directly to the pole.
- Mounting them on a cross arm and associated hanger bracket.
- Mounting them on a supporting platform.

Maximum mass of transformers to be mounted on poles:

- Bolt fixed without mounting plate 750 kg.
- Bolt fixed with mounting plates 1750 kg.
- Cross arm Hung 2150 kg.
- Platform Mounted 2700 kg.

10.1.3 Installation

Spare transformers can remain in a yard for many months subject to the ingress of moisture that could affect the integrity of the transformer.

Standard three phase and single phase transformers must be installed and tested in accordance with:

- Any requirements listed on design plans and Works Orders issued for the job;
- Requirements in the Overhead Construction Manual;
- The work practice Pole Mounted Transformer Installation Replacement & Testing;
- The transformer voltage ratios are appropriate for the installation;
- The vector group (3 phase installation) is appropriate for the application;
- All bushings are in good condition;
- The breather cap, where fitted and tagged, has been removed;
- The oil level is correct and there are no leaks;
- The tank is correctly connected to the High Voltage (HV) earth;
- The transformer has the correct height clearances and clearances from other structures;
- Where applicable, surge diverter(s) have been fitted; and
- Correct type and size of LV output fuses have been fitted and the fuse cartridge size is of the correct rating to provide protection of the transformer.

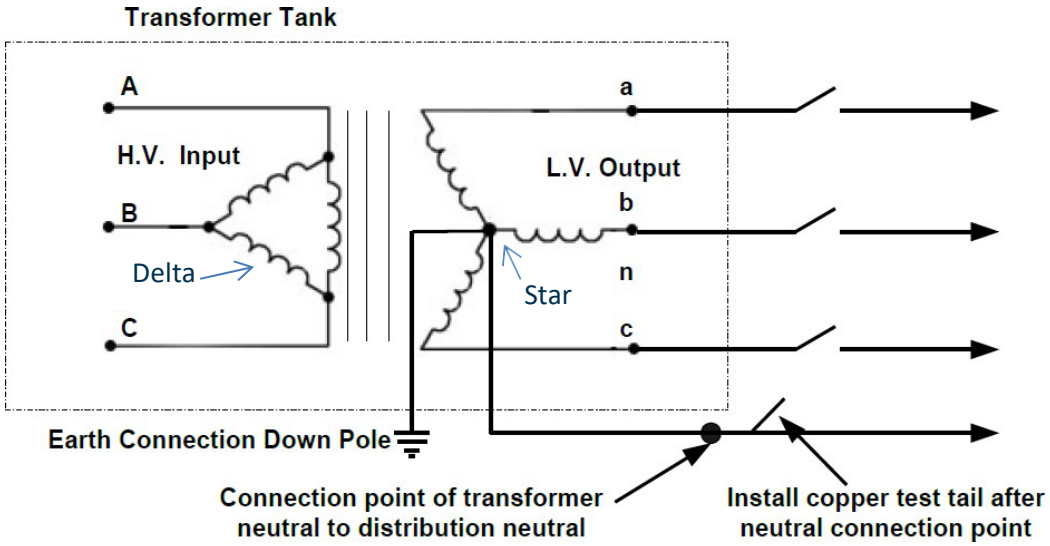
10.2 Three Phase Transformers

Transformers are available in different sizes ranging from 50kVA up to 500kVA output to match different customer total loads.

Where the total customer load is less than 50kVA. This is likely to occur in outlying areas where the number of customers are low and spread out and single phase transformers are normally used to supply these loads.

Where the total customer load exceeds 500kVA, ground mounted substations are installed to supply the load.

10.2.1 Standard Wiring Configuration



Although it is possible to have other configurations (Star to Star), the standard wiring configuration for pole mounted transformers is Delta to Star as shown in the above diagram.

10.3 Standard Single Phase Transformers

Single phase transformers are normally installed where there are no LV overhead distribution mains conductors, only HV conductors but, there is a need to supply LV to one or two customers. This usually occurs in outlying rural areas.

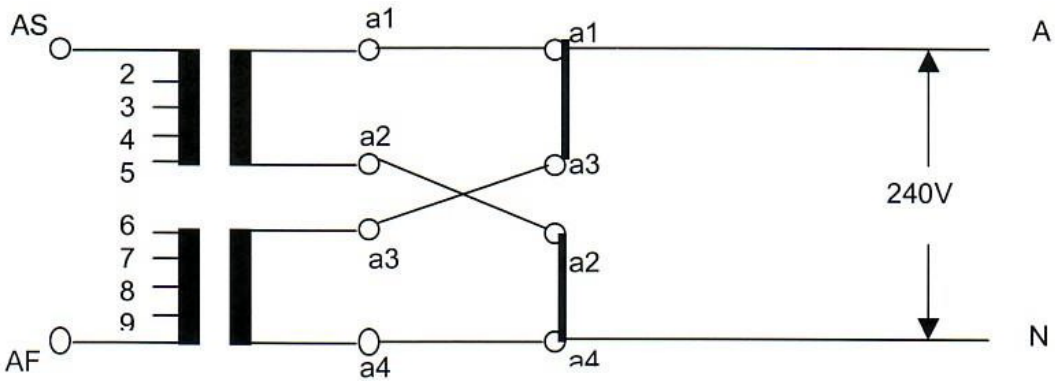
The main precaution to be taken with these transformers is to ensure that the neutral or earthed terminal of the low voltage winding is connected to the neutral conductor.

Single phase Distribution transformers used on the Distribution System have four low voltage bushings marked, a1, a2, a3 and a4. These can be configured to supply a two wire or three wire system.

10.3.1 Standard 240V Configuration

This is the normal standard configuration and has bushings **a1** and **a3** bridged out and **a2** and **a4** also bridged out with a copper busbar. This configuration allows for a two wire 240 volt LV system taking advantage of the full rating of the transformer.

By convention, the **a1-a3** connection is the nominated Active connection and the **a2-a4** is the nominated Neutral connection. This arrangement delivers a nominal voltage of 240 volts. See wiring diagram.

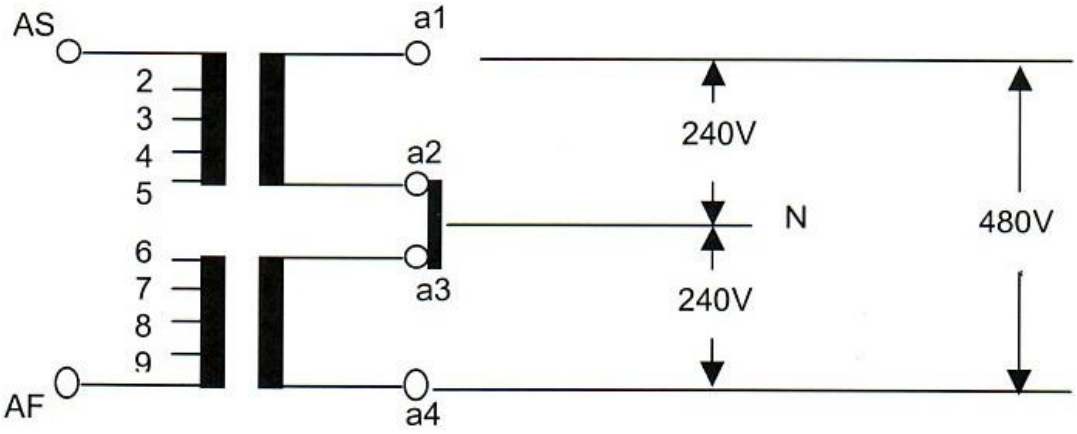


Two Wire System – Standard 240 volt Arrangement

Split Phase 480 V Configuration

In this arrangement, only half the capacity of the transformer is utilised. Remove the busbars between **a1 and a3** as well as between **a2 and a4.**

Connect a busbar between **a2 and a3**. By convention, for a 240 volt supply, we have **a1** as the Active and **a2-a3** as the Neutral for one phase and **a4** as the Active with **a2-a3** as the Neutral for the other. A 480 volt supply can be supplied from **a1 and a4**. See following wiring Diagram.



Three Wire System – Split Phase Supplying 2 x 240 volt Supplies and 1 x 480 volt Supply

The three wire system is convenient for supplying two customers from the same transformer provided neither customer total exceeds half the rated kVA output from the transformer.

In addition, care must be taken to ensure 480V is not inadvertently supplied.

11.0 PUBLIC LIGHTING

Hydro Tasmania designs, installs and maintains a public lighting system through an arrangement with public authorities.

Public lighting schemes are designed to comply with the relevant part of the Australian Standard Public Lighting Code AS1158.

The final responsibility for nominating the lighting to be used rests with the public authority concerned. It is compulsory the minimum standard be maintained at intersections, roundabouts and other areas where high traffic density exists.

In general installation of lighting apparatus and circuits shall comply with the Distribution Design Standard - Public Lighting, available from Tas Networks website.

11.1.1 Street Lighting

Ground mounted lighting is installed on street lighting columns. These columns come in a range of styles, types and sizes to suit particular requirements of street lighting. They can vary in length from 6.0 metres to 18.0 metres. They can be circular or octagonal, wide base or narrow base.

Examples of Street Lighting Poles

12.0 CONDUCTOR DETAILS AND CURRENT RATINGS

The conductor details and current ratings listed in this section will only cover those conductors that are now being installed in the distribution system.

Details on standard service cable size can be found in the Service Installation Rules. A copy is available on the TasNetworks internet, contractor page.

12.1 Overhead Distribution

	Size & Type	Current Rating* (amps)	Weight per Metre	Stringing Tensions Limited	Medium	Full
Low Voltage	7/3.00 AAC	127 - 240	0.13 kg.	Yes	Yes	--
	7/3.00 AAAC	127 – 237	0.14 kg.	--	--	Yes
	7/4.50 AAC	198 - 398	0.30 kg.	Yes	Yes	--
High Voltage	3/2.75 SC/GZ	29 – 53	0.14 kg.	--	--	Yes
	7/3.00 AAAC	127 – 237	0.14 kg.	--	--	Yes
	19/3.25 AAC	238 – 595	0.43 kg.	Yes	Yes	--

***Lower current rating** = "summer". **Higher current rating** = an average of day and night values over the "winter" period.

12.2 LV Aerial Bundled (ABC) Conductors

	Size & Type	Current Rating	Basic Span Length Tension in metres Limited & Medium	Weight per Metre
Low Voltage	2 Core 50 mm^2	205 – 260 amps	45 & 75	0.35 kg.
	4 Core 50 mm^2	155 – 195 amps	45 & 75	0.70 kg.
	2 Core 95 mm^2	295 – 365 amps	45 & 75	0.68 kg.
	4 Core 95 mm^2	235 – 300 amps	45 & 75	1.35 kg.
	4 Core 150 mm^2	295 – 430 amps	N/A 75	2.02 kg.

Lower current rating = "summer". **Higher current rating** = "winter" period

13.0 CONNECTIONS

13.1.1 Factors to be considered when selecting connectors

- Effects of the thermal expansion cycle on the connection;
- Creep and stress of the various metals;
- Relaxation of the various metals;
- Ingress of moisture;
- Connection of dissimilar metals; and
- Oxidation and corrosion.

Where connectors are used to join copper and aluminium conductors – copper MUST be installed below the aluminium.

When preparing an electrical connection it is important to:

- **Select** the **correct connector** for the SIZE & TYPE of conductor; and
- **Correctly prepare** the **conductor surfaces** to be jointed.

It is vital to ensure that the conductors to be joined are thoroughly "cleaned" with a wire brush. Inhibitor grease MUST only be applied to "clean" conductor immediately after the conductor has been cleaned.

The INHIBITOR GREASE or jointing compound is designed to prevent air and water reforming "oxides" and to provide continuing protection against corrosion of the electrical connection. "Grease", when deposited around the contact surfaces prevents the penetration of oxygen and the forming of oxide.

13.1.2 Select Correct Connector

The type of "connector" selected will depend upon the size and type of conductors being joined. For example, whether it is copper or aluminium, bare or insulated, how many strands and what the size of each strand is.

The type of connection used will also depend upon whether the conductor(s) being connected are exposed to the weather, or are under tension.

Refer to the data supplied or the appropriate Network Manual as per the following:

Bare conductors - Distribution Overhead Line Design & Construction Standard.

Insulated LV conductors - Low Voltage ABC Manual.

Insulated HV conductors - High Voltage ABC Manual.

Underground conductors - Underground Cable Design & Construction Manual.

Street lighting conductors – Street lighting Design & Construction Manual.

13.1.3 Correctly Prepare Conductor Surfaces

Conductor surfaces could be covered by a thin layer of oxide that is electrically NON-conducting. This is especially so with BARE conductors.

This “oxide coating” MUST be removed from the conductor BEFORE the conductor can be joined / connected. This oxide coating will return quite quickly after it has been cleaned off the conductor and because of this, it is necessary to apply inhibitor grease and / or make the connection IMMEDIATELY after the conductor has been cleaned.

Refer to **Overhead Construction Manual** for details on all connection types, methods and assemblies used for connecting HV and LV Power Distribution Conductors.

13.1.4 Compression Connections

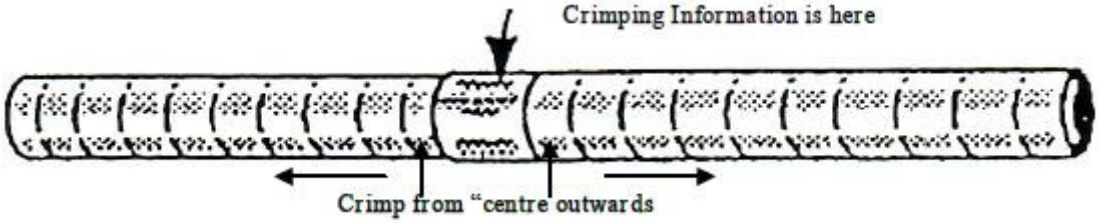
With all compression connections, to avoid joints coming apart, it is critical to ensure you use the correct size compression die to suit the conductor size and compression sleeve to be used. Hydraulically operated crimping equipment is used for compressing the “connectors” installed on aluminium cables and aerial conductors. This “equipment” comes in a wide range of types and sizes suitable for a range of activities.

Samples of Different Types of Compression Tools & Dies.

Conductors must be fully inserted into the sleeve.

Crimping should start at or near the centre of the sleeve and successive crimps should be made alternately working outwards towards the ends of the sleeve. Rotate the crimping tool 180° after each crimp preventing curvature of the sleeve. Do not crimp past the first crimp line which may damage the sleeve.

This allows the conductors to expand freely inside the sleeve until the joint is completed. Many crimps are numbered indicating the correct order in which crimps are to be made.



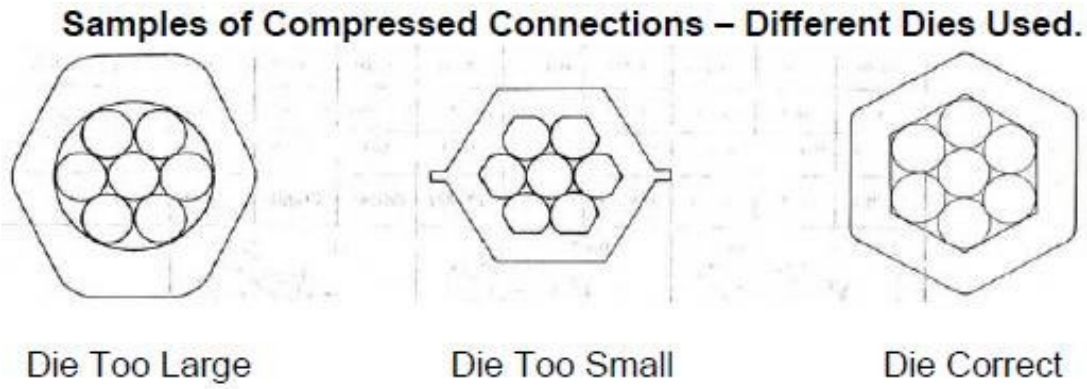
Non-tension Compression Sleeves are suitable for overhead and underground low tension joints in industrial and commercial installations.

They are suitable for aluminium conductors and in some cases galvanised steel conductors.

Full Tension Compression Sleeves are suitable for full tension joints in overhead distribution lines.

They are suitable for all aluminium alloy and aluminium cored steel reinforced conductors.

Refer to the **Distribution Overhead Line Design & Construction Standard** for details on the above sleeves.



In summary when making compression connections:

- Insert conductors into the correct depth and hold firmly;
- Select correct "tool" and correct "die" (matched to compression sleeve);
- Position in correct place on "sleeve" to commence compressions. This is starting from either right or left of centre of the sleeve and then working outwards to the end;
- Compress to correct depth;
- Reposition and continue correct number of compressions in correct positions; and
- **Note**. The principles applied here are similar with "Crimped" connectors.

13.1.5 Bi-metal Crimp Lugs

Electrical connections used on an air break switch, with either copper, aluminium or steel conductors need to be made off and capable of withstanding wide variations of weather and load conditions.

This is done using bi-metal crimp lugs and stainless steel bolts and washers, tightened to the required tension.

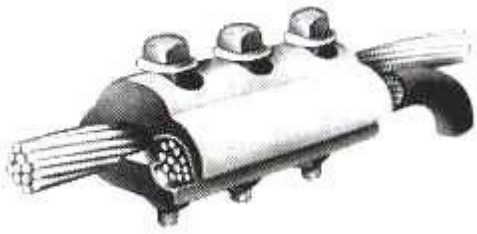
Conductors must be thoroughly cleaned and for aluminium conductors, "inhibitor" grease must be applied to the conductor before insertion into the crimping lug.

Refer to the *Distribution Overhead Line Design & Construction Standard* for details on connectors.

13.1.6 Bolted Connections

Parallel Groove Clamps supplied for use with aluminium conductors come with an "inhibitor" grease compound lining the conductor grooves.

The inhibitor ensures optimal contact between the clamp and the conductors to minimise joint resistance, and where dissimilar metals are being connected, reduces the possibility of cable / joint deterioration due to the effects of electrolysis.



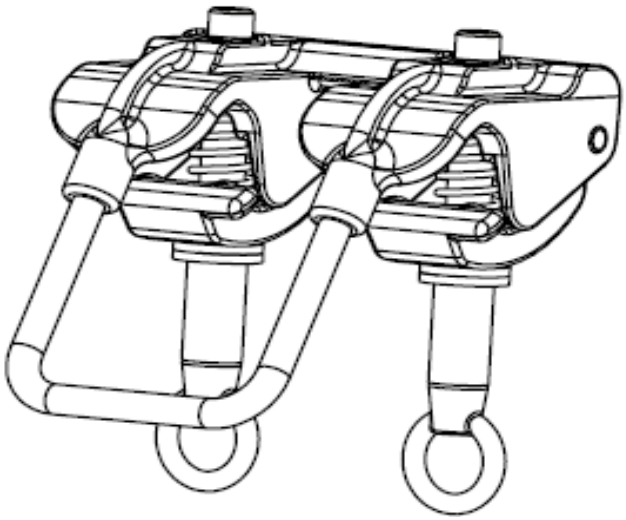
- **Ensure conductors are correctly cleaned or prepared with a wire brush**;
- Ensure inhibitor grease is applied where required;
- Position both conductors in connector correctly;
- Tighten all bolts evenly and uniformly over the "connector". Five cycles are required to reach a uniform contact pressure; and
- **The centre bolt on this clamp should be tensioned first then remaining outer bolts, increasing tension uniformly across the clamp.**

Refer to the **Distribution Overhead Line Design & Construction Standard** for details on size and types.

Two parallel groove (PG) clamps will be used instead of one parallel groove clamp for connections of preformed leads on tensioned conductors.

13.1.7 Double Spindle LL Clamp

Used for connecting line side EDO droppers (Single LL clamp) to the main conductor, double clamping arrangement maintains circuit integrity. Provides disconnection ability from the main line (Feeder) without an outage - allowing replacement of EDO assemblies etc. 700 mm safe approach distance applies at all times.



Inhibitor grease must be applied to the aluminium conductor immediately after it has been thoroughly cleaned. Refer to the **Distribution Overhead Line Design & Construction Standard** for further details.

13.1.8 Insulated Piercing Connections (IPC)

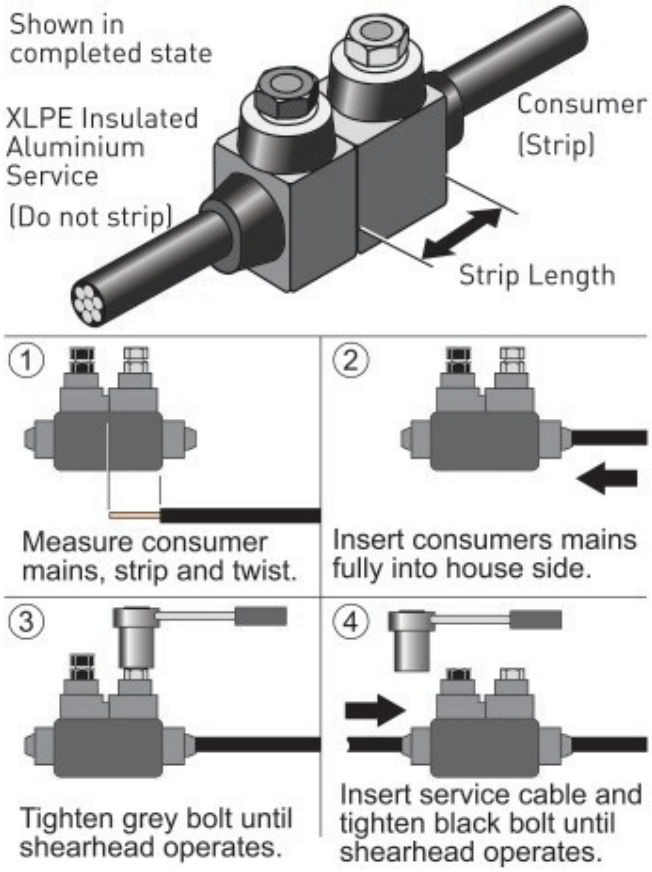
Cable Piercing connections are used on Aerial Bundled Conductors (ABC). The cable end with the insulation still intact is inserted into the terminal of the aerial connector, and the top nut of the terminal screw is tightened with a ratchet type socket spanner especially designed for this task

The terminal screws have “teeth” on the end that pierce the cable insulation when they are tensioned up. They must be tightened up until the top nut shears off.

This ensures that the terminal screw is tensioned sufficiently to make a reliable contact with the conductor. A second nut below the shear nut provides the capability to subsequently release the connection and remove the conductor should the need arise. It is important to use the “correct” size and type connector for the particular type of insulated conductor.

Refer to the Distribution Overhead Line Design & Construction Standard for details on connectors for Aluminium XLPE Services.

- Strip correct length of insulation from conductor where required;
- Position conductor(s) into correct IPC; and
- Tighten up bolts to correct torque and shear off.


Shown in completed state
XLPE Insulated Aluminium Service
(Do not strip)
Consumer
(Strip)
Strip Length
1
Measure consumer mains, strip and twist.
2
Insert consumers mains fully into house side.
3
Tighten grey bolt until shearhead operates.
4
Insert service cable and tighten black bolt until shearhead operates.

14.0 Installing Customer Service Apparatus

14.1 Overhead Services

The installation of new overhead customer services shall comply with:

The TasNetworks Service and Installation Rules.

14.1.1 Equipment for Straining Service Conductors

Typical cable strain grip and come along on ABC service

Selection of strain grips for use on bare and insulated service cable

The standard methods used are:

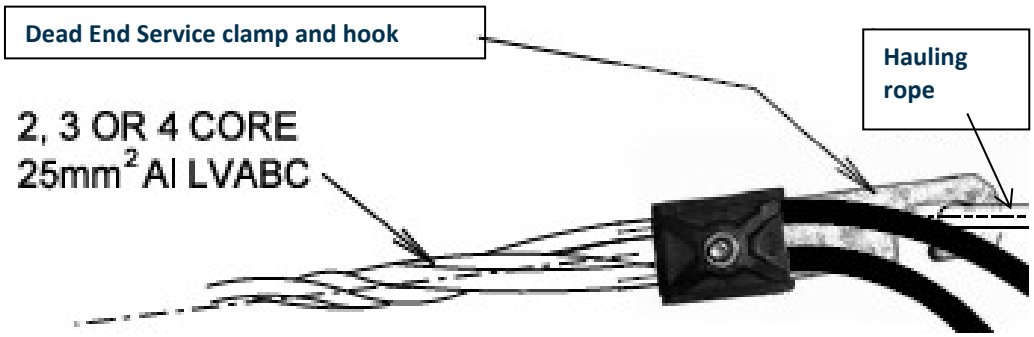
- hauling line — Used for shorter cables and shorter spans.
- comealong
- ratchet puller

Used for heavier cables/longer spans.

The following is an example of a hauling line being used – otherwise known as a Rope Snotter.

Line Snotter to Haul Up Service

Another approved method is to use an appropriate Dead End clamp suitable for the service wire to act as a grip to strain.



14.1.2 Service height clearance from Ground and Structures

Location Description	Direction	Insulated Service Conductor Clearance
At centre of carriageway	Vertically	5.5m
At kerb line (bottom of kerb)	Vertically	4.6m
At verge	Vertically	3.0m
At fence alignment	Vertically	3.0m
At fence alignment (from top of fence)	Vertically	2.0m
Private driveways and land traversable by vehicles more than 3m in height (except service stations, farms, caravan parks and other high-risk locations)	Vertically	4.6m
Areas not normally accessible to vehicles	Vertically	3.0m
Unroofed terraces, balconies, sun decks, paved areas etc. that are subject to pedestrian traffic only	Vertically	3.0m
	Horizontally	1.0m
Roofs or similar structure not normally accessible to persons but on which a person may stand	Vertically	2.0m
	Horizontally	1.0m
Covered places normally accessible to persons, including for example windows capable of being opened, roofed open verandahs and covered balconies	In any direction	1.0m
Blank walls / windows which cannot be opened	In any direction	1.0m
Other structures not normally accessible to persons	Vertically	2.0m
	Horizontally	1.0m
Gas Storage Cylinders	Horizontally	1.5m
Swimming pools.	Vertically	Not permitted
	Horizontally	3.5m
Rotary clothes line, Radio/TV antennae.	Vertically	0.6m
	Horizontally	0.1m
Areas where trailable sailing craft, farm machinery and irrigation pipes may be used	Vertically	5.5m
Service Poles in the vicinity of bare OH conductors (refer HV clearances table for conductors greater than 650V)	Vertically	-
	Horizontally	-
Caravan parks	Vertically	5.5m
Service station and farm driveways	Vertically	5.5m
Telephone or Broadband Communications Cables	Vertically	1.2m

All clearances are a minimum to which a conductor may sag or swing under any of the following conditions:

a. Rated maximum conductor temp in still air (75^{o}C)

b. Conductor temperature of 15^{o}C with a wind pressure of 350pA?(blowout condition)

c. Conductor temperature of 5^{o}C in still air

An additional 200mm to vertical clearance shown measured under normal stringing temperature is to be added to allow for sag increase under maximum operating conditions.

14.2 Standard Service Cable Sizes

The service conductor details and current ratings listed here will only cover those conductors that are now being installed in our distribution system.

There are other sizes and types of service conductors still within our Network but not addressed here. Details on these conductors can be found in the Distribution Overhead Line Design & Construction Manual.

Cable CSA (mm^2)	Conductor material	Cable Cores	Service rating (Amp)	Common Use
25	Aluminium	2 core or 4 core	100	Domestic
50	Aluminium	1 x 4 core	170	Commercial, Agricultural sites
95	Aluminium	1 x 4 core	300	Commercial, Distribution

14.2.1 Maximum Span Lengths

2 25mm – 1phase	46m
2 25mm - multi phase	33m

Length of span from pole to pole can be greater. This is determined by required clearances, size and type of pole, size of conductor, insulation type, type of service clamp and environmental considerations

14.3 Overhead Service Fuses

To be mutually agreed, design improvement for the installation of ABC mains boxes and service fuse locations.?

14.3.1 Installation

The installation of customer service fuses shall comply with:

- The SIR (Service Installation Rules) requiring:
  - The Point of Attachment and Service Fuse(s) must be accessible from a ladder firmly footed on the ground; and
  - Service Fuse(s) must be accessible directly from ground level to enable disconnection of supply by fuse sticks.
- The SIR for Stratum Titled Development;
- The SIR for underground consumer's mains on a private service pole;

- The SIR covering underground consumers' mains installed on a Hydro Tasmania pole; and
- Allowable location for installing the service fuse will depend on how the service is supplied to the customer installation and must comply with one of the allowed options in the SIR.

The Overhead Line Design Construction Manual details remaining technical requirements for installation of fuse fittings in conjunction with service brackets and service strains etc.

14.3.2 IPC Connections

When installing IPC connectors, the shear bolts are designed to break off at a certain kN using the correct tightening tool. Using an incorrect tool can cause the head to shear off prematurely resulting in an unsound joint.

Therefore, with shear bolts onlym use an approved spanner (ABC Spanner) for tightening the bolts and:

- Adjustable spanners are not to be used as these tend to damage the plastic shear head.
- Do not exert a bending force on the shear head, because the shear head may break prematurely.
- Ensure spanner is in such a position that a sudden release cannot cause any bodily harm. The connector should be held firmly when tightening the bolt.
- Tighten the bolt of the connector until shear head releases. This ensures that the correct torque has been applied and that proper contact is achieved.
- Do a solid tug test to confirm the shear bolt has pierced into the conductor and made a sound connection.

14.3.3 Underground Service From Pole

Underground services must comply with Hydro Tasmania:

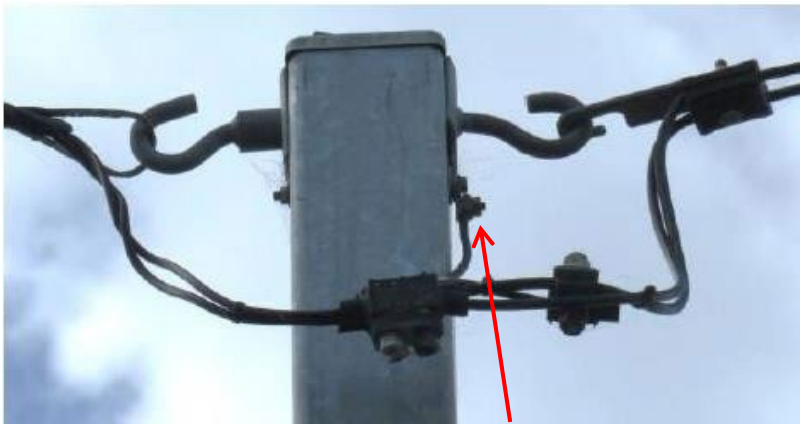
- Overhead Line Design & Construction Manual; and
- Service & Installation Rules

14.3.4 Neutral Bond on Steel Poles

The following three examples are **INCORRECT** ways of bonding the main neutral to a steel service pole.

The **CORRECT** way to bond a steel service pole is via the following method shown, which complies with the Overhead Line Design Construction Standard.

- The main neutral is connected straight through and, a tail is taken from the main neutral and bonded to the pole.
- This means, if the bonded tail should ever come loose or break off, there will be no issue with floating voltage appearing on the steel pole to harm the public, as the main neutral is still solidly connected and is not part of the pole bond.



CORRECT Method - tail taken from main neutral to bond the pole.

In accordance with the **Overhead Line Design Construction Manual,** all steel service poles, cross over poles and intermediate poles must have the neutral bonded to the pole via the correct method except on poles used to support a meter box. If unsure of meter box being installed or meter box is for temporary building supply and will be removed later on – for safety bond the pole.

15.0 LIVE WORK – TESTING & COMMISSIONING

15.1 Live Low Voltage Work

Work must be scheduled or planned to be completed isolated or de-energised. Live Low Voltage (LV) must be risk assessed and approved by the production manager before commencing. Work may be conducted energised ONLY if it can be justified and executed SAFELY in the following circumstances:

- Supply is needed to do the job (testing, commissioning); for example connection of a customer service must be on a live circuit only, reason being neutral must be confirmed for connection otherwise potential exists for livening the customer installation; and
- Safety concerns: Safety or health risk from disconnecting power is higher than the electrical safety risk of performing the job energised

Regardless of the above requirements, if an electrical worker has concerns that they cannot carry out the live task safely, then work must not proceed.

The following tasks are examples of work that cannot be performed live:

Ref No.	Description of Task
1	**Replacement / installation of *LV* surge arresters.**
2	**Maintenance or repair work on pole mounted distribution transformers** (e.g. repair oil leaks; replace bridging and *LV* leads; repair burnt terminal on transformer LV bushing or repair burnt neutral connection to transformer tank or any LV that encroaches the HV exclusion zone).
3	**Making or breaking electrical connections at consumer's terminals** in overhead network supplied areas without isolating the load or removing the primary fuse.
4	**Fitting *LV* switch fuse units on an *LV* Panel.** Replacement or addition of an *LV* switch fuse unit on existing *LV* panel on all switchboards e.g. in Padmount substations and ground substations, *LV* cubicles, distribution boxes, etc.
5	**Access to rear of Padmount LV switchboards** shall not be gained by leaning over the top.
6	**Teeing off UG mains cables.**
7	**Live LV work on the ground using non-insulated tools**. All work in cabinets/pillars, where any parts are energised, is not permitted with un-insulated tools (e.g. vice-grip pliers). *Note: Insulated tool kits are available for this purpose*
8	**Changing all metering equipment,** except changing of plug in meters and applying / removing temporary metering recorders (e.g. polyloggers).
9	**Connection of Mobile Generator leads to Padmounts or Switchboards,** except where there is: • a dedicated generator connection point on the LV switchboard, or • sufficient bare bus to use insulated screw up generator leads, or • captive nuts or thread on the busbar designed for generator lead connection, or *Note: using bolts with non-captive nuts on live parts is not permitted* • a Combined Fuse Strip (CFS) that can be opened and the generator leads bolted to the de-energised palms of the CFS. Current to be limited to the CFS rating.
10	**Installation or maintenance of spreaders or spacers on conductors**
11	**Working on isolated HV in close proximity to energised open LV**

12	**Work on or near live bus bars in switchboards**

15.2 Compliance to Construction Standards

All construction and electrical work must be done as detailed in the relevant Standard(s) applicable.

For Line Workers, the Standards for compliance are:

1) Hydro Tasmania covering work performed up to the POS:
   - Overhead Construction Manual;
   - Low Voltage ABC Manual;
   - Public Lighting Manual; and
   - Service and Installation Rules.
2) The AS/NZS 3000 Wiring Rules and associated Standards, covering electrical work performed on privately owned electrical assets beyond the POS.

15.3 Visual Inspection and Electrical Tests

To avoid the risk of electrical shock and damage to assets, as an Electrical Practitioner you must ensure via careful inspection (check for loose parts etc.) electrical tests where applicable, that all electrical apparatus you have worked on is electrically compliant and free from fault before energisation and commissioning.

Following are the key electrical tests that must be performed where applicable.

15.3.1 Continuity Test

This test is very important to ensure that the main neutral circuit is not broken from the transformer output to the end termination, as a broken neutral could cause issues e.g. a floating neutral on a polyphase supply could cause a voltage higher than 240V that could damage customer appliances.

15.3.2 Standard Insulation Test

This test is relevant for work on electrical apparatus and conductors (e.g. HV and LV ABC conductors) to ensure low resistance (a potential fault condition) is not found between, phases and, each phase to neutral and to earth.

15.4 HV and LV Earth Tests

To ensure public safety and minimise risk of damage to electrical apparatus, the correct resistance values of earths are critical to ensure protection equipment will operate and operate quickly should a fault to earth occur.

Where a HV and/or LV earth wire has been installed, an earth resistance test shall be conducted in accordance with the work practice.

15.5 Completion and Certification of Work

It is important that Service Providers must ensure all work has been "certified" as being electrically compliant, to construction standards and free of fault, before energisation and commissioning by filling out an Electrical Work Certification (EWC) check list (if provided or obtained from Hydro Tasmania) or a Certificate Of Electrical Compliance (CEC) form and;

This paperwork must be provided to Hydro Tasmania before any Hydro Tasmania employees taking over responsibility to energise and commission the apparatus is installed by the Service Provider.

15.6 Hydro Tasmania Employees

Line Workers must complete the relevant sections on testing and also the section covering InfrastructureWork on the Electrical Work Certification (EWC) check list and date and sign the EWC to "certify" the work is compliant and apparatus is free of fault before energising and commissioning.

15.7 Preparation Before Commissioning

Handover by Service Provider

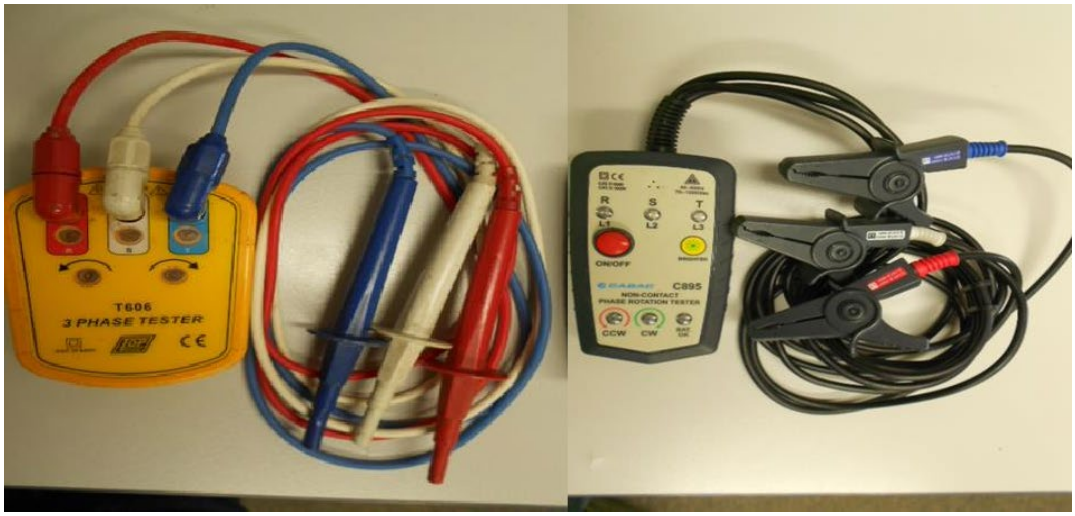
To avoid possible damage to apparatus from an electrical fault, Hydro Tasmania employees **SHALL NOT** under any circumstance connect, energise and commission electrical apparatus worked on by a Service Provider until "certification" paperwork and accompanying electrical test details have been received from the Service Provider beforehand and checked as being properly dated and signed off as being valid.

15.8 Check Existing Phase Rotation/Sequence

Before a three phase service is replaced, a phase rotation is required to determine what the existing phase rotation is, so the same final phase rotation test after energisation of the new service reads the same.

Also, correct polarity shall be proven before the phase sequence test (prove 3 phases are present).

There are different styles of phase sequence testers available, but operating principles of each type are the same. Direct and Non Contact



Standard connections should be the following when conducting testing.

Clock wise arrow is standard rotation  ,

Anti-clockwise is non-standard rotation  .

Before testing double check connections etc. are correct as an incorrect/false indication may occur if:

- One or more phases is de-energised;
- The test leads are incorrectly connected;
- One or more leads have an open circuit; and
- One or more phases are the same.

15.8.1 Phasing Out

During commissioning, HV or LV phasing out may be required across two supplies of different origins and if so, phasing out must be conducted in accordance with the work practice steps.

15.8.2 HV Phasing Out

See TasNetworks Work Practice Phasing Out Using Fameca HV Tester

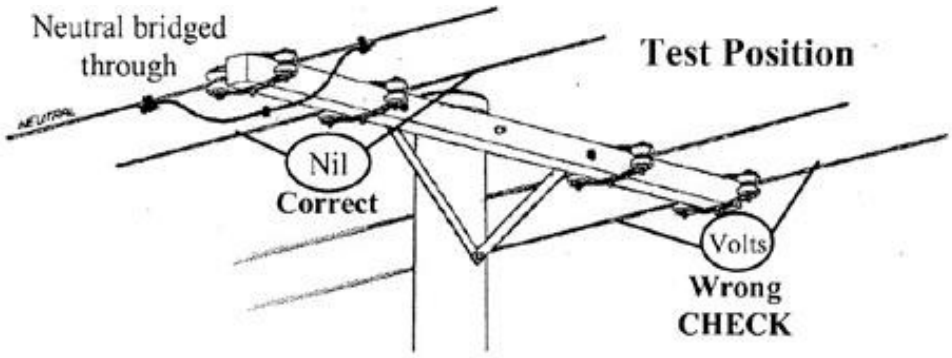
15.8.3 LV Phasing Out

There are times when two separate low voltage circuits need to be connected in parallel to keep supply on as a result of a faulty transformer or when a transformer may need to be replaced or upgraded.

This can be done by:

- Closing a set of low voltage isolators / links where circuits are already phased out;

- Phasing out across an open point and fitting jumpers or loops across the two circuits to be paralleled. To do this :



Identify the neutral conductor in both circuits, if not continuous.

Prove that all other conductors are alive using approved tester and Retest Tester after a zero reading.

Bridge the neutral conductors together if not already connected.

Test across phases in opposite circuits and find two corresponding phases that give a zero voltage reading.

Retest tester and if O/K connect these two phases together.

Repeat this process with remaining phases.

Special Notes:

- A 415 volt reading between phases of opposite circuits indicates the phases are "out of phase" and cannot be connected together;
- A zero reading indicates they are "in phase" and can be connected together;
- A 240 volt reading between phases of opposite circuits indicate that one phase is alive and one phase is dead; and
- **Do NOT assume that because "links" are installed at "open points" that the low voltage circuits WILL phase out. ALWAYS test first, using approved testing method, to ENSURE the "phases" are correct and will parallel.**

Test for Stray Voltage on Assets

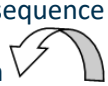
To ensure public safety, before leaving the site, it is a good idea after completion of commissioning to do a simple test for any stray voltage that may appear on assets (e.g. voltage on steel pole neutral bond or voltage tracking through an insulator) using a LV and/or HV proximity tester.

If any stray voltage is found then trace out and fix the problem if you are able to or make the site safe from the public (isolate or barricade) until assistance arrives to fix the problem.

16.0 COMMISSION CUSTOMER INSTALLATIONS

Where a section of overhead LV distribution mains has been altered or installed as new and/or, customer services have been upgraded or installed as new, Line Workers must ensure they perform all relevant electrical tests required up to the POS (normally at the point of attachment to the consumers mains) in accordance with the LV Testing Procedure and;

It is the Line Workers responsibility to ensure:

- All electrical apparatus before the POS has been properly tested and is electrically compliant and free of fault before handing over to Electrical Practitioner – Electricians to complete the commissioning and testing of installations from the POS onwards;
- All steel service and cross over poles are properly bonded and electrically tested as being correct; and
- Phase sequence/rotation is standard for all new three phases services installed i.e. clock wise arrow shown on phase rotation/sequence tester is standard rotation.  , Anti-clockwise is non-standard rotation 

16.1 Certification of Completed Work

After completion of commissioning, all electrical work and associated infrastructure construction and maintenance work performed on the Power Distribution System must be certified as performed to a satisfactory standard in accordance with the construction standards used and issued by Hydro Tasmania via;

- Hydro Tasmania employees filling out and signing the relevant sections covering electrical and infrastructure work in the CEC form; and
- Service Provider employees filling out a similar form provided by the Service Provider, such as a Certificate of Electrical Compliance (CEC).

16.2 General Asset Inspection

Major defects with aged assets should have been picked up via the Asset Inspector during routine inspections. However, in case anything has been missed you should conduct a general inspection when on site to check for any defects.

Use the following documents that contain example pictures of defects to look out for and what level of severity the defects are rated at as a guide on what needs to be done to fix the problem found.

Asset Inspectors use TasNetwork's Overhead Defect Photo Manual to detect issues.

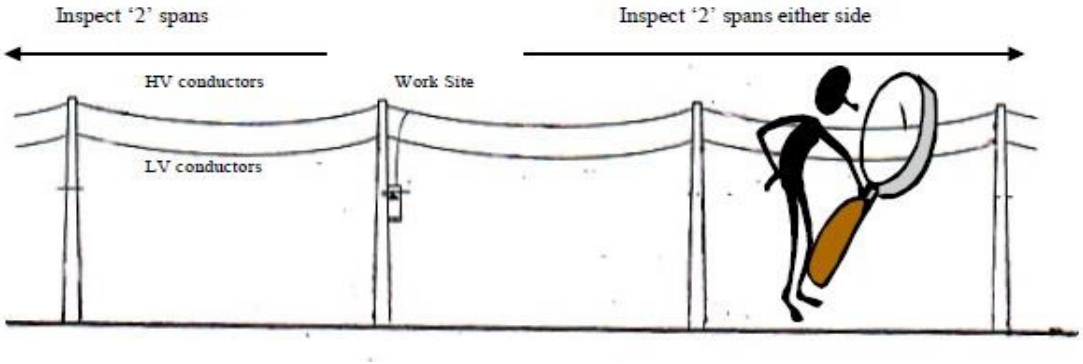
Distribution Asset Inspection Manual (Reportable Defects Section).

16.3 HV Conductors

16.3.1 Suspect or Substandard HV Conductors

When required to carry out work on poles supporting older type high voltage conductors as detailed below – the conductors must be treated as "suspect" to failure if a sudden significant strain is placed on them.

To ensure these conductors are SAFE to work under – a thorough visible inspection of each conductor – up to TWO SPANS either side of the proposed work - shall be done to check they are FREE of corrosion or damage to conductor strands.



16.3.2 Likely Strain to HV Conductors

The following type of work could produce a sudden significant strain:

- Straining of low voltage conductors.
- Tensioning of stay wires.
- Straightening of the pole.
- Mounting and removal of pole type transformers, reclosers, etc.
- Fitting of live line clamps to conductors.

The inspection of the HV conductors must be done using magnifying mirrors (or other suitable means e.g. Go Pro Camera) fitted to insulated sticks or preferably from the bucket of an Elevating Work Platform.

The conductors must be "closely" inspected along their length and especially at:

- Tie positions on insulators.
- Conductor joint positions.
- Places where connectors are fitted.
- Near the pole where the work is to take place.

16.3.3 Multi Circuit HV Overhead Lines

BOTH Feeders are required to be isolated and earthed with access to the Feeder performed under Permit to Work conditions.

Before

17.0 LV DISTRIBUTION MAINS CONDUCTORS

Before working on or near aged LV distribution mains conductors, especially if they are energised, care must be taken to perform a thorough inspection for such things as, corrosion, damaged or broken strands, suspect joints and, signs of arcing marks from conductor clash on long spans that may:

- Be a potential safety risk (e.g. high chance conductor might break) where controls need to be put in place to mitigate against this;
- Be a potential fire hazard risk (.e.g. conductors clashing); and
- Not be an immediate risk now (e.g. worn conductor) but may be a longer term risk.

17.1 General

Only persons who have been appropriately trained for the work to be carried out and are qualified in accordance with Hydro Tasmania, safe work practices are permitted to work on or in close proximity to LIVE Low Voltage exposed conductors.

They shall be correctly dressed in approved clothing with sleeves to wrist length and trousers to ankle length. They shall wear, an approved safety helmet, safety footwear and, low voltage insulated gloves inspected before use.

Jewellery such as watches, rings, bracelets, necklaces, body adornments and wedding rings must not be worn.

Safety glasses shall be worn when making / breaking electrical connections or working with hard drawn conductors. Persons required to work on or near live low voltage exposed conductors shall be attended by another employee who is competent in the appropriate electrical rescue procedure.

When assessing and mitigating the risk persons shall comply with the following:

- Specific requirements detailed in this handbook and any associated SWMS, Safety Policies/Procedures, Work Practices and Work Procedures for working safely on or near live LV or in situations where apparatus may become inadvertently live from another LV source else, in the absence of this;
- The safety principles contained in Hydro Tasmania Safe Work Practices;
- Adequate insulating barriers, such as line mats, must be used to cover all conductors and conductive material within reach and;
- This could include stay wires, street light brackets and other steel components, especially on steel and stobie poles;
- Conduct a sound risk assessment and implement safety control measures; and
- Ensure a Safety Observer or Assistant is nearby to check SADs will not be breached by plant/machinery and persons and;
- A Pole Top rescue kit is placed at the base of the ladder, with personal harness available for immediate use. (Confirm if required to be worn by assistant, unit of competence); and

- When working aloft, using appropriate insulating line mats etc., as shown to protect against inadvertent contact with live LV

17.1.1 LV ABC Distribution Mains

If you notice a low span of LV ABC the cause may be a faulty suspension clamp failure so inspect and replace with the current approved clamp.

Older style clamp | Older style clamp with failure | Current clamp with reinforcement

17.1.2 Cutting away and releasing conductors

It should be noted that poles which have been inspected and appear to be "sound" may be weakened by decay or rust below ground level.

A sudden and significant, unbalanced load at the pole top such as that caused by the cutting away or releasing of tension in conductors can result in pole failure.

Line workers and others should be aware of the need for special precautions when conductors have to be released or cut away from poles. This is critical with heavy conductors and old poles. Precautions to be adopted will need to be considered in the light of the circumstances associated with each situation.

CAUTION: Every endeavour shall be made to arrange the work so that unless the pole is stayed or otherwise secured – conductors shall not be released from the pole WHERE it could allow the pole to move or to fall.

- Releasing LV conductors below live HV:
    - If a risk assessment deems the risk will be low (e.g.control measures in place such as insulated guy ropes to prevent the conductors from whipping up) then the station must be contacted to implement live line suppression - one trip to lock out before the conductors being released.
- If HV conductors above LV conductors are being released then you must ensure the LV conductors below are de-energised and isolated;
- Check each pole is secure before releasing conductors. If not, hold pole secure by attaching crane or other suitable method (e.g. temporary stay);
- In all cases where it is necessary to remove conductors from a pole each conductor shall be held by a rope, or rope blocks, while being released and then lowered to the ground;
- Under no circumstances shall conductors be cut through and allowed to drop to the ground, the sudden shock loads applied to the pole could cause failure;
- Set up a safe work zone clear of where conductors and associated apparatus may fall and make sure unnecessary persons are kept clear of the work zone. Barricade if necessary (e.g. to guard against public access); and

- Take into consideration if the conductor is an aged suspect or substandard conductor in accordance with the policy and if so, implement the safe work guidelines detailed in the policy.

17.1.3 Temporary Support of Conductors

- It is permissible to use temporary LV cross arms under live HV conductors for replacement of old LV cross arms;
- An inspection of conductors and associated apparatus a minimum of two spans either side of the work site; and
- If the inspection finds suspect apparatus that may fail or aged suspect conductors then, the work team would need to assess if safe to proceed under live conditions and if so;Set Feeder Protection
- The following methods are intended to cover temporary support of LV conductors e.g. when performing LV cross arm replacement work. However, the same principles can be applied for temporary support of HV conductors but, in doing so you must ensure :
    - The equipment used for temporary support has the correct insulating properties for use with live High Voltage and;
- If you are using temporary LV cross arms to support energised conductors then you must ensure you use correct methods for performing live LV work

  Correct use of SADs, PPE and insulating material (mats, covers etc.).

The objective of using the temporary V push up cross arm is to enable efficient and easy replacement of LV cross arms with the LV conductors still energised, using live LV work practice methods.

The temporary V arm can only be used on wooden power supply poles due to the restricted attachment arrangement not being suitable for attaching the V arm to steel, concrete and stobie poles.

17.1.4 Replacing Cross Arms

When replacing cross arms, especially old deteriorated cross arms with conductors connected at an angle to the cross arm, care must be taken to ensure insulator pins and ties don't suddenly give way and release the conductor(s) without warning.

When working aloft, ensure you are always on the side opposite to where the conductor(s) would suddenly release to outside the angle.

A safe way to replace old cross arms is to mount a temporary cross arm to lift, support and take the strain of the conductors, leaving the old cross arm free to be easily removed and replaced.

Work Steps for using the V arm

Minimum of two man crew if using an EWP else;

- Minimum of three man crew if working off ladders (e.g. Ladder either side of the pole); and
- Affix support bracket to side of pole as shown just below the wooden cross arm king bolt.

- Fit the temporary V arm to the support bracket as shown and lock it into position with the safety pin as shown.

- Attach the conductor holders as shown ready to lift and place the conductors in.

- Unbolt each insulator pin rod, pull the insulator pin out, and then place each conductor into its holder as shown below.

Note: As shown above, where practical to do so, leave the insulator pins tied to the conductor so the pins slide out of the old cross arm and are then ready to push into the new replacement cross arm and;

To maintain SADs remove and support the outer pins first before the inner pins.

- Remove the old cross arm as per normal work practice.
- Affix the new replacement cross arm.
- Lift up each conductor from the support holder and reinstall the insulator pin.
- After the cross arm work is completed remove the V arm and conductor supports.

17.1.5 By Suspension

The following shows a temporary cross arm that suspends the conductors. This type of cross arm is beneficial for use over the top of the conductors if there is restriction below. It has an attachment for use with round poles and also for non-round poles such as the Stobie Pole shown below.

If you have any of these temporary cross arms in use, apply the safe work principles as above for the V type cross arm.

17.1.6 Push Up Conductors Using Ratchet Temporary Cross Arm

The above method, using a T-MAC ratchet up temporary cross arm, is ideal to lift conductors from below if there is restriction in working above the conductors. Again, apply the safe work principles as above for the V type cross arm.

17.1.7 Across Road Ways

The safety concern with stringing conductors across roadways is persons taking a risk in running conductors across the road during a break in traffic and not being able to raise the conductors high enough in time to avoid being snagged by passing traffic. This can be a major safety issue and must be avoided by conducting a risk assessment and implementing the following options:

- A sound traffic management plan – which may require implementation of STOP/SLOW BAT to stop traffic movement until the conductors are soundly tensioned up to a safe height.
- The use of EWPs enabling the height required to lift conductors clear of traffic.

17.1.8 ABC Conductors

The maintenance replacement and upgrade of existing LV ABC conductors shall comply with the following requirements.

- TAS Networks Overhead Line Design & Construction Manual; and
- **LV ABC Design and Construction Manual**.

17.1.9 Tensioning Conductors

With existing conductors, care must be taken not to over tension aged substandard conductors of the type detailed in the Policy on Substandard HV Distribution Conductors and;

In accordance with the Policy, a risk assessment must be done and where there is any doubt at all the supply must be isolated before working on the conductors and/or associated infrastructure.

17.1.10 Work On Live LV Using a Ladder

Employees shall ensure there are adequate insulated covers (mats and / or sleeves) for the job and they are in good condition. Covers may need to be secured so they cannot be dislodged or blown off conductors.

Poles shall be checked for "soundness" before climbing or working on them. If in **any doubt** the pole shall be supported **before** commencing work.

A pole top rescue kit shall be positioned at the base of the ladder.

Ladders, when used shall be positioned to provide the safest and most suitable working position. Ladders shall be held secure or firmly tied off to prevent them falling or moving, causing an employee to lose their balance or possibly fall.

17.1.11 LV Services Attached To Cross Arm

When replacing any cross arm with an LV service attached to it, you must comply with the requirements under the Service and Installation Rules, which may require an upgrade of the service if the height is too low or if the service is substandard or any associated fittings are substandard.

17.1.12 Fibreglass Reinforced Plastic (FRP) Cross Arms

Full details on how to correctly use and install Fibreglass Reinforced Plastic Cross Arms are contained in work practice Fibreglass Cross Arms Handling. The following is a summary of the key points.

Fibreglass cross arms are a direct replacement for aged cross arms. It is the intent to progressively use fibreglass cross arms in all applications where galvanised cross arms have previously been used. The benefits of using FRP cross arms are:

- Lower overall cost as cross arms will last the lifetime of the pole;
- Half the weight of existing cross arms; and
- Exceptional performance in the BSI environment, including insulation properties mitigating the occurrence of pole top fires.

The FRP cross arms can be damaged during transport so care must be taken to use packing material where the arm may be resting on something abrasive.

The cross arms come predrilled from the supplier with Hydro Tasmania specified existing hole placements and hole sizes. **FRP cross arms cannot be sawn or drilled.** Modifications in this manner can significantly reduce the strength of the cross arms and expose workers to breathable the fibreglass fibres.

If FRP cross arms are found to be broken and fibres are exposed then a class P1 or P2 dust mask and gloves must be worn when handling. Fibreglass cross arms are fitted with internal blocks at each pre-drilled hole, this prevents the fibreglass cross arm from being crushed. This allows the use of all types of impact drivers, electronic and hydraulic.

18.0 LINE WORK - FAULT RESPONSE

18.1.1 General

Persons performing fault response may encounter conditions such as, Electrical Storms, Floods, Bush Fire, Severe Winds, Ice and Snow – the work must be conducted safely in accordance with these work practices:

Although there may be pressure to rectify a fault and restore supply as soon as possible safety comes first. If deemed unsafe, you must stop work until conditions improve or seek help and additional resources making it safer to perform the work.

18.1.2 Fault Response Safety Rules

- To manage fatigue, do not exceed Hydro Policy on the maximum number of continuous works hours before a break is required;
- First response person on site - secure and make safe before carrying out any other task;
- Do a Risk Assessment, do not expose yourself or any member of the public to increased risk;
- Do not leave site until people, vehicles and property are safe from critical risks. Contact Emergency Services (Fire, Ambulance etc.) where necessary;
- When site is secure and safe, proceed with supply isolation and prove dead, and install temporary earths to conductors / apparatus as required;
- Do not cut any conductors supporting a fallen pole or tree. Release tension in conductors first by lifting heavy object off using a suitable crane or cutting tree or branches away with chainsaw (if safe to do so);
- When fault has been fixed, communicate with the Power Station to advise them of supply restoration and then, remove local earths and re-energise power supply; and
- Carry out all relevant electrical tests. If tests are correct, restore supply to customer(s) and report details.

When responding to a fault, gather as much information as possible about the nature of the fault for recording in the specified Hydro Tasmania Asset Event.

18.1.3 Basic Steps to Locate Fault

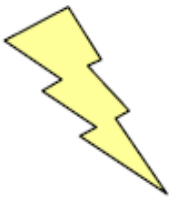
Fault indicators can be installed on lines where frequent outages occur.They continuously monitor line condition through electric and magnetic fields.

They provide visual indication for a range of fault types using Xenon indicators and coded Light Emitting Diodes that flash in prescribed codes to indicate the fault type. This is shown below.

Line Tracker LT30 Indicator System Guide.

The following “guide” is to be used for “reading” the results of the Line Tracker Indicator.

Xenon Flash 1 flash every 4 to 8 seconds
(4 seconds during daylight and 8 seconds at night)



Permanent Fault has occurred within the last 4 hours and the supply is off. The indicator will reset after 4 hours or when power supply is restored.

Red LED Flash burst every 10 seconds indicates most recent fault seen in the last 7 days.

3 ● ● ● = Permanent Fault.

2 ● ● = Transient Fault.

1 ● = 'Self Clearing Fault'

Amber LED Flash burst every 30 seconds indicates the current line status.

3 ● ● ● = No Voltage present on line.

2 ● ● = Voltage on line but zero or low amps

1 ● = Everything is normal & indicator OK

O = Check battery volts on indicator.

The Line Tracker will indicate the "location" of a fault in a section of line by the colour and action of the LED's of respective Indicators.

18.1.4 Access at a Fire Scene

If you arrive at a fire scene ahead of the Fire Brigade, your obligation is to assess the situation and isolate electrical supply where it is safe to do so.

When emergency services arrive at the scene, follow all instructions communicated by the Fire Officer / or the Police. Do not interfere with any evidence on site as it may be subject to an ongoing investigation. (Potential crime scene)

18.1.5 Removal of Overhead Service:

Where fire has badly damaged a domestic installation, it may be necessary to isolate the electricity supply and make safe by removing the service.

- If you are able to do so, take readings from electronic meters before isolating the power. Electro-mechanical meters can be read afterwards;
- Disconnect power supply to the building (electrical installation);
- Disconnect the service tails at the pole top;
- Completely remove the service conductor from the Point of Attachment;
- Cap and insulate the ends and roll the service conductor up attaching it to the pole in a safe and secure position, at least three (3) metres above the ground;
- Notify the customer (if present) and the Fault Centre; and
- Notify Hydro Tasmania of the meter readings so they can be passed onto the Electricity Retailer

18.1.6 Isolate To Point Of Supply

Where damage is less severe there may only be a need to isolate and make safe back to the POS, service fuse.

In this situation:

- Comply with the work practice Isolation of LV Services; and
- Notify the customer (if present) and the Fault Centre.

18.1.7 Fuses

In compliance with the current Distribution Switching Operations Manual, if during fault response, any one of a set of fuses is to be replaced, all the fuses in that set must be replaced.

For example – a 3 phase service or EDO with one faulty fuse – replace all three fuses.

While attending to the fault, visually check the rest of the service(s) and associated fittings, attachments, etc. for general safety condition.

18.1.8 Sectionalising

Sectionalising is the process where sections of the distribution network are sequentially de-energised and re-energised to locate the fault.

Once the fault is located and isolated, priority shall be given to restoring supply to customers outside the isolated section.

18.1.9 Manual Reclose of HV Apparatus after Fault Operation

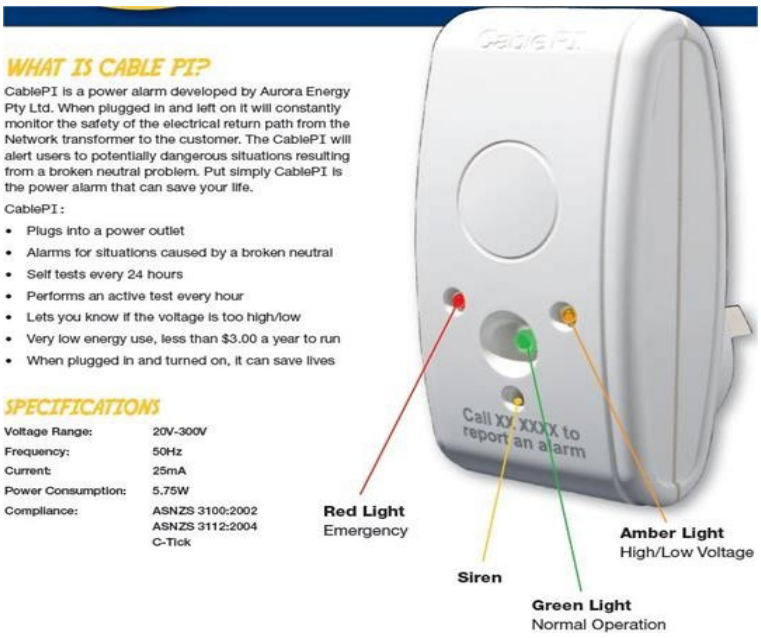
IS IT SAFE TO RECLOSE?

The following procedure shall be applied to reclosing after fault tripping of high voltage feeders.
http://ourknowledge/sites/operations

18.1.10 Site Inspection

Comply with any immediate directions given by the Operations Fault Centre and report what you find on site. Based on a risk assessment of the conditions and any immediate hazards that may affect public safety a carry out any further instructions given to make the site safe.

18.1.11 Cable PI Response



The Cable PI Device was introduced to assist the public with electrical safety, with the device plugged into a customer's power point monitoring LV supply and informing the customer via an alarm if a fault is detected e.g. broken neutral or low voltage etc.

To know what to do on fault response, Line workers need to understand how the Cable PI operates and what all the alarms mean and what to do aboutthe type of fault that the alarm gives an indication of.

Follow the work practice Attending Cable PI Faults to assist with Cable PI faults and rectify the problem up to the Point Of Supply (POS) if you are able to. Otherwise make the site safe where necessary and/or isolate as per work practice Isolation of LV Supply and report for immediate follow up and repair.

18.1.12 HV or Lightning Contact with LV Apparatus

Reported damage to a "number" of installations:

The main overhead circuit shall be left disconnected until all customer installations have been inspected:

Reported damage to a "single" installation:

- All installations supplied from the same overhead main circuit shall be checked for damage before restoration of supply. If no other damage is found, the circuit shall be restored, with the damaged installation left disconnected until it has been inspected. If hydro assets are not damaged and no visual damage to the customer services, restore supply to the installation. Circuit protection equipment is in place to protect the customer installation.

No reported damage but possible or known HV and LV line contact:

- The main overhead circuit shall be left disconnected until all customer installations have been inspected; and
- Inspection of these affected installations shall be in accordance with the Work Practice HV contact with LV and Lightning Strike Guidelines.

19.0 DUTY OF CARE CUSTOMER INSTALLATIONS - SITE INSPECTION

Generally, fault response work by Hydro Tasmania employees and Service Providers would be restricted to the electricity supply infrastructure up to the point of supply (POS) and the metering equipment.

It is the customer's responsibility to engage an Electrical Contractor to rectify faults related to consumers' mains, customer switchboard and circuits beyond.

However, where customer safety may be an issue, all Hydro Tasmania employees and Service Providers carrying out electrical work have a duty of care when conducting fault response work to ensure the electricity supply is not left in an unsafe state for customers, even if this means checking areas of the electrical installation that would normally be performed by an Electrical Contractor.

In addition to faults, site inspection could reveal problems related to non- electrical compliance (e.g. noncompliance to AS/NZS 3000 Wiring Rules) and/or revenue protection issues (electricity theft, tampering, damage etc.)

19.1.1 Isolation of Supply Customer Issue – Disconnect for Safety

Where a site inspection identifies an issue likely to cause fire or shock the attached notice applies:

HT Notice of Disconnection of electricity supply for Safety BSI 10-20.pdf Located in BSI shared Folders.

19.1.2 Issue Notice for Non-Compliant Installation

Where an installation is identified as non-compliant the customer is required to have the defects rectified without delay:

The customer must be issued with a Hydro Tasmania HT Notice of Disconnection of electricity supply for Safety BSI 10-20.pdf to engage an Electrical Contractor for rectifying the non compliance. Located in BSI shared Folders.

19.1.3 Reconnections after Fault

Hydro Tasmania will require a copy of the Certificate of Electrical Compliance (CEC) from an Electrical Contractor requesting a reconnection after fault.

This helps protect Hydro Tasmania from connecting an installation that has not been appropriately "certified" as compliant. All Electrical Contractors have been advised of this change. Hydro Tasmania will require a copy of the CEC for reconnection after a fault as outlined in the following steps:

- Electrical Contractor to take a photo of the completed CEC;
- Contact Hydro Tasmania nominated manager; and
- If the site has been upgraded (not a like for like connection, e.g. OH to UG) or it is more than 10 business days since disconnection an EWR will also be required.

19.1.4 Non-Compliant Earth Connection

Example of defective earth connection

It is important to ensure all earths have a solid connection and low resistance value.

Report any poor customer earth found to the customer to arrange an Electrical Contractor for repair as soon as possible. As backup also report this issue to Hydro Tasmania, Electrical Contractor Nominated Manager.

19.1.5 Servicing Faults

Perform a visual check at the POA when you arrive looking for obvious signs of a poor connection:

- Connection Type;
- Service cable type;
- Service cable size;
- Point of attachment type; and
- Point of attachment condition

NOTE: 55 amp Stanger fuses or flat ribbon cables must be replaced

Poor IPC connection

Broken service neutral at pole

Broken service neutral at POA

19.1.6 Switchboard Faults

Test all metallic parts for voltage using a volt stick or independent earth and multi meter.

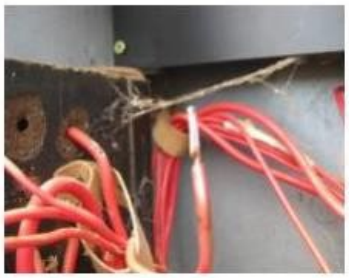
Burnt out fuse

Poor rewirable fuse wedge contact

Poor termination / corrosion on link

Failed active bus on federal switchboard

Loose RCD connection



Termination loose - over heating

20.0 FALLEN CONDUCTORS

Fallen HV or LV conductors must be treated as alive until you have proven de-energised by:

- Testing with an approved tester. If found live; barricade the site first and then; notify the Power Station to isolate supply or, isolate the supply at a local level if you are authorised to do so (e.g. operate Load Break Switch or remove Transformer fuses).

20.1.1 Damaged or Fallen Power Pole

Could be a fallen or badly leaning pole caused by impact from a vehicle or damage from bushfire or flood erosion.

20.1.2 Do not cut any conductors under tension

Release the tension (by lifting the heavy object with a crane or similar) before cutting.

20.1.3 Poles Damaged By Fire

CAUTION: Wooden poles and cross arms in the distribution network are treated with Copper Chrome Arsenate (CCA) to extend the life of the wood. CCA is hazardous to our health and can be absorbed into the body through smoke, char and ash from burning or fire-damaged poles. Inhalation can lead to nasal and other respiratory cancers.

- Isolate and make safe any pole subject to fire.
- Once isolated, utilise the on Island Fire Service to extinguish any burning poles.